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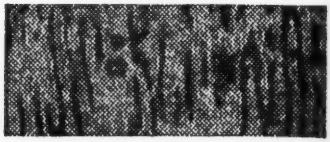
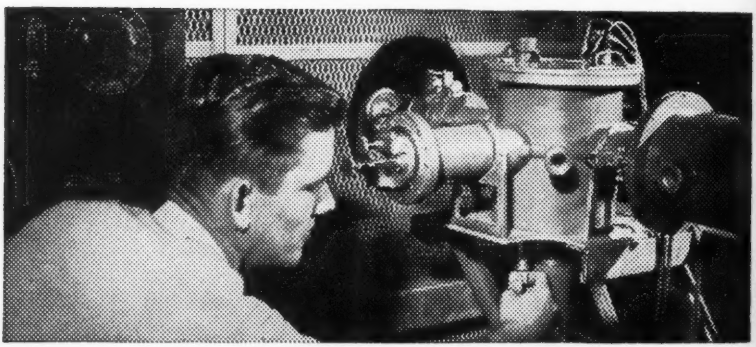
The American Society for Engineering Education

Electrons probe the future

1 Electron micrograph of an alloy of aluminum, nickel, cobalt and iron. Magnification 20,000 diameters.



2 Cooled from high temperature in a magnetic field, the alloy becomes a powerful, permanent magnet. Note changed structure. Black bars reveal formation of precipitate parallel to the applied field. Each bar is a permanent magnet.



3 A Bell scientist adjusts electron diffraction camera. Electrons are projected on the specimen at glancing angles. They rebound in patterns which tell the arrangement of the atoms . . . help show how telephone materials can be improved.

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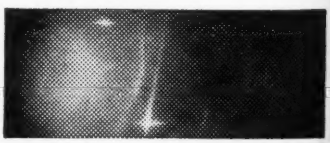

4 Diffraction pattern of polished germanium reveals minute impurities which would degrade the performance of a transistor.

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The Thayer School offers complete curricula in civil engineering, electrical engineering, and mechanical engineering accredited by the Engineers Council for Professional Development. A fourth curriculum, in engineering and business administration, is offered by the Thayer School in conjunction with Dartmouth's Amos Tuck School of Business Administration.

The objective of the engineering curricula is to educate men for professional careers of public responsibility as well as for technological activities. Through its close association with Dartmouth's liberal arts program, the School is in a position to render a unique service in the field of engineering education. The professional engineer of today has both an obligation and opportunity to direct his technological endeavors toward the service of society. In order to do so he must have an understanding and appreciation of the needs and problems of the world in which he lives, which cannot be acquired in a course of study limited to scientific and technical subjects. The engineering student at Dartmouth follows a pre-engineering course for three years in the liberal arts college before entering the professional school. During these three years, he acquires a background of both general education and science courses in the atmosphere of a liberal arts college and in association with liberal arts students. This association is continued through his first year in Thayer School in the Great Issues course which is required of all Dartmouth seniors. Building on this foundation of education in the humanities and the social and natural sciences, the engineering studies offered by the Thayer School prepare men for the broadest possible usefulness both within the engineering profession and in community life.

Between thirty and forty students are normally admitted each year, and the enrollment in each of the four curricula offered by the school will therefore average less than ten students per year. Classroom sections are limited to twenty students and seldom exceed fifteen. Laboratory sections are generally held to ten students. This limited enrollment makes it possible to provide intensive instruction under close personal supervision and to realize fully the benefits to be derived from close contact between student and instructor.

Centennial of Engineering

In welcoming representatives of engineering schools throughout the country to the 1952 Annual Meeting of ASEE, Dart-

mouth observes the centennial of engineering instruction on her campus. Just one hundred years ago, civil engineering courses were initiated as part of the program of the Chandler Scientific School established at Dartmouth in 1852 by gift of Abiel Chandler. After the establishment of the Thayer School in 1871, the Chandler Scientific School became a department of the College and it has subsequently been absorbed by the Science Division, but civil engineering instruction has been continued on the Dartmouth campus without interruption for one hundred years. It is an interesting coincidence that 1952 also marks the hundredth anniversary of the founding of the American Society of Civil Engineers and is being observed throughout the country as the centennial of engineering in the United States.

The Thayer School was established by the gifts of General Sylvanus Thayer whose underlying thought was that the preparation for an engineering curriculum must be a liberal arts college course which should entirely precede the work in the professional school. Sylvanus Thayer was graduated from Dartmouth in 1807 and from the United States Military Academy in 1808 with highest rank in his class in both institutions. At the age of 32 he was appointed Superintendent and assigned the task of reorganizing the Military Academy. One of his biographers has said of him, "Major Thayer's military experience, his foreign travel and associations, his familiarity with the polite usages of society, his dignified bearing and refined mode of life, and, above all, his scientific acquirements, enlarged professional reading and familiarity with the French and dead languages, gave him immense vantage ground for success." Between 1817 and 1833 he made the United States Military Academy one of the most famous and effective military schools in the world. In recognition of his work the Academy has erected a monument on its campus, and he is generally regarded as "the father of the Academy." He spent the closing years of his life planning an engineering curriculum based on the experiences of his own career. This work culminated in the founding of the Thayer School in 1871, just one year before his death.

Preparation for Professional Careers

Although Thayer School graduates are prepared and qualified to continue their formal education in specialized graduate work leading to more advanced degrees, and some have done so with signal success, the school's primary objective remains, as conceived by its founder, to prepare its graduates for professional engineering careers. Both the arrangement of the

programs and the instructional methods are aimed at the accomplishment of this objective by placing the emphasis on breadth and the study of fundamentals and avoiding narrow specialization.

The pre-engineering courses required during the first three college years are the same for all curricula and about two-thirds of the work of the fourth year consists of engineering fundamentals common to all curricula. Through individual counseling by members of the Thayer School faculty, students are advised to choose electives during the first three years from the offerings of the social science and humanities divisions in order to take fullest advantage of the opportunity to broaden their educational experience. An incidental but important feature of this arrangement is that the student may postpone his final choice of engineering field until the beginning of senior year when he is far better qualified to choose his field of study than during freshman or sophomore year. It is also possible for the student to transfer without stigma or penalty from engineering to another area of study at any time during his first three years if it appears that his interests or aptitudes lie outside the field of engineering.

In the fourth and fifth year courses in specifically civil, electrical, or mechanical engineering subjects the theoretical and practical fundamentals are stressed. Except for the individual or small-group projects in the fifth-year curricula, all courses are required for all students enrolled in each of the three programs offered.

Instructional Methods

Instructional methods are designed first to instill in the student the habits and procedures of engineering analysis and workmanship and, having accomplished this, to provide him with maximum opportunity to develop judgment, initiative and self-reliance in the performance of assigned tasks and projects. In classroom, design and laboratory periods, every attempt is made to keep the student participation factor as close to 100% as possible. Student maturity and small enrollment are felt to be vital factors in making these instructional procedures possible and fully effective.

Thayer School is particularly fortunate in its physical plant. After "making do" in traditional New England fashion in a series of buildings converted from their original use for other departments, the school moved into the Horace S. Cummings Memorial in 1939. This building was expressly designed and newly con-

structed to meet the needs of the civil engineering program offered by the school at that time. Immediately after World War II, two wings were added to house the new electrical and mechanical engineering programs. This complete unit stands at the west end of Tuck Mall just opposite the Tuck School of Business Administration and three hundred yards west of Dartmouth's central building, the Baker Library. It will be open for inspection throughout the week of the Annual Meeting and ASEE members and guests are cordially invited to visit the building and view the laboratories, engineering library, and other facilities at any time.

The Third National Surveying Teacher's Conference

Sponsored by

Committee 8, Civil Engineering Division, ASEE

and

The University of Illinois

August 3–8, 1952

Camp Rabideau, Summer Surveying Camp of the University of Illinois, will be the scene of The Third National Surveying Teacher's Conference, August 3–8, 1952. Situated in the Chippewa National Forest of Northern Minnesota and in an area famous for its lakes and Paul Bunyan lore, Camp Rabideau with an unparalleled physical plant and pleasant woodland environment offers excellent facilities for conference activities and communal living.

The Illinois Surveying Camp is located on federally-owned forest land in Beltrami County about 35 miles northeast of Bemidji. Deer and small game abound in the heavy stand of second-growth timber that covers this region. Daily rail and bus service is available from Minneapolis to the village of Blackduck which is 6 miles north of the camp. Good highways approach the area from all directions.

For further information address Brother B. Austin Barry, F. S. C., Chairman Committee 8, Civil Engineering Division, ASEE, Manhattan College, New York 71, N. Y.

Dining and sleeping accommodations will be furnished at a cost of about $25 per person for the six-day period. A reduced rate will be made for children. Reservations should be made with Dr. M. O. Schmidt, Director of Camp Rabideau, Surveying Building, University of Illinois, Urbana, Illinois.

Higher Education and the Problems of This Decade[1]

By J. HILLIS MILLER
President, University of Florida

Any problematical approach to the decade of the 1950's involves a great deal more than higher education. However, that higher education is an important factor in the solution of these problems is an assumption which we make at the very beginning. Since this paper is to deal almost exclusively with higher education, it follows obviously that the discussion as a whole will be incomplete and inconclusive. Moreover, any brief statement of this kind will not include even a listing of all the problems of this decade, and, because of the limitations of time, the discussion will not exhaustively nor adequately set forth, even from an educational point of view, those problems that are brought within the focus of attention.

We shall not discuss the traditional functions of higher education such as its function of teaching citizens to think, to search for truth, and to make decisions in terms of the best information and knowledge that is available to them. We shall not discuss professionalism in higher education, nor types of higher educational institutions. We shall not attempt to define higher education, and thus run the risk of detracting from the pastime of many educators who spend their energies dealing with invidious comparisons as to the specific theories of higher education. We shall not dwell upon the inertia of higher education, nor its failure to train the wills and intellects of men and women for whatever functions they may be called upon to serve. In fact, we shall not discuss higher education from the point of view of higher education at all, but rather from the point of view of society. Higher education, for the sake of this discussion, becomes an instrument for meeting some of the problems of our society. Therefore, its own problems are disregarded to a very considerable extent in order that attention may be focused upon society itself. Indeed, such an approach is good for higher education since in losing its life in service to the world it may well find it again.

Assumptions

Having in this fashion cut through the mangroves that surround any discussion of higher education, we are in position to make certain positive assumptions as we discuss the new role that higher education should play in connection with some of the pressing problems of the society of which we are a part.

First of all, we assume that higher education has a mental hygiene of its own. To state it another way, we assume that higher education possesses a vigor and healthy-mindedness that will enable it to make its contribution to the solution of the pressing problems which are present today and which will unquestionably persist in the decade of the 1950's. If higher

[1] A speech given at the Commodore Hotel, New York City, September 27 and 28, 1951, sponsored by the American Council on Education. Originally appeared in *The Educational Record*, Oct., 1951, and published here by consent of the author and the American Council on Education.

education is to lead the way, it must dismiss the sense of futility which pervades the thinking of so many men and women today. For example, many good church members despair of being able to halt the trend toward secularism, and many good democrats (in the generic sense of the word) seem to feel that we have to forsake democratic procedures in order to defend democracy.

There are a number of additional assumptions which should be listed if the new role for higher education is to be understood. It must assume that we can profit from the mistakes of the past as well as the successes of the past. It must assume that the rights of the ordinary man are to be protected. It must assume that the mind and will of man are more powerful than all other forces in the world. It must assume that unmitigated speed is not as effective as the slow and tedious process of human thought. It must assume that science is a neutral factor and that it can be used for the upbuilding of civilization. It must assume that man's organizational ability to get things done can be turned in the direction of the orderly development of man's life on earth rather than that it must be used for the destruction of our world. It must assume that inevitable change can be turned in the direction of service to mankind rather than in the direction of man's ultimate destruction. And it must assume that permanent peace is obtainable. All of these assumptions, and more, must be made if higher education is to make its contribution to mankind during the next decade.

Unorthodox Approach

The approach we are making to the function of higher education and its contribution to the solution of the problems of the next decade is an unorthodox approach. Higher education cannot go its own way, and in its old ways, if it is to meet the needs of the time. It must carry on many of its old functions: it must continue to admit students to classes and curriculums and it must graduate them from colleges and schools and send them out into the world. We are not suggesting that higher education should subtract from its present activities so much as that it must add to them. It should not digress from its traditional pattern of service so much as it should aggress into areas that need its attention. We suspect that many of the new functions of higher education, which we shall suggest, are in areas which are now covered by the activities of higher education. More intensified tilling of the soil and more aggressive action in many of these areas are in order.

With these limitations and assumptions in mind, we may attempt to underline the areas of tension and danger in our society to which higher education must effectively and aggressively give its attention.

It is the function of higher education to redefine a desirable civilization. This problem is outlined in some detail by William H. Kilpatrick in the May 1951 issue of *Educational Theory*. There are many points at which we would differ with Kilpatrick's position, particularly with his concept of individualism. However, his definition of a desirable civilization is challenging: "Freedom, freedom to be one's self, freedom to work out one's own position in the group as opposed to the hereditary caste system of feudalism; equality, equality of treatment before the law, equality with others affected to decide what the law shall be and who shall govern, as opposed to arbitrary government by hereditary rulers, 'equal rights for all, special privileges for none'; freedom of thought, freedom to think, to speak, to argue, to persuade, to publish as each might wish as opposed to dictation and repression along all these lines; specifically, freedom of religion, freedom to believe or not to believe and to say so, as one's own study and conscience shall decide with legal freedom to support any religion or none as each may choose."

Kilpatrick goes on to say that these things mean democracy with its active respect for personality wherever found. It is the responsibility of higher education in this country during the next decade to show

the conflict between this kind of definition of a desirable civilization and the conflicting definitions of "civilizations" which have resulted in the social tensions of our world. These tensions are not clearly defined, and, consequently, our concept of a desirable civilization is not clear. It may be that the American view of a desirable civilization is best understood as a radical departure from the traditional European patterns. Moreover, the term "Oriental" covers so many diverse and fundamentally different cultural patterns that we find difficulty in deciding what we contrast with American democracy. Likewise, the secular, parliamentary government of India is not Oriental, and if it is not American or European it certainly is much more like them than like the earlier Oriental despotisms. The chances are that these difficulties can be circumvented by reference to the several ancient cultural patterns of Asia now emerging from colonial domination and seeking ways through the morass of poverty and ignorance toward something different. The tensions arising over the conflict between Russian communism and democracy are more clearly defined. Even here the conflicts are emotionally charged and leave much to be desired from the point of view of intellectual clarity.

Higher education must face the fact that the mass hysteria of our times makes it almost impossible for anyone to think honestly or to speak frankly on these issues for fear of being branded radical or subversive. As President Truman pointed out in Detroit on June 28, 1951, this fear has reached extreme proportions. On that occasion he said, "On the fourth of July over in Madison, Wisconsin, people were afraid to say that they believed in the Declaration of Independence. A hundred and twelve people were asked to sign a petition that contained nothing except quotations from the Declaration of Independence and the Bill of Rights. One hundred and eleven of those people refused to sign that paper—many of them because they were afraid it was some kind of subversive document and that they would lose their jobs or be called communists." We confess a certain suspicion concerning this incident, but the kind of thing suggested here makes the battle against communism a confused one, with the result that too many people on all levels are simply taking on a kind of protective silence on the theory that what they do not say cannot hurt them. This leaves the real concept of democracy singularly defenseless among the very people who should be its leading exponents. Higher education must do more than "face the fact"; it must, by its very nature, provide an antidote to fear and hysteria. Its weapons are scholarship and enlightenment.

Higher Education Must Inspire Statesmanship

Higher education must redefine the functions of politics and government in a democratic civilization. The field of political science, as it applies to the history of social organization and to the government of the people must undergo a thoroughgoing review by higher education, in order that we may bring to an end the trend toward bad government and establish once again true government of and for the people. There is a very general trend today for politics to destroy good government as well as good education. To state the matter in more positive terms, it is a function of higher education to define not only good government but good statesmanship as a means of developing and maintaining good government. Higher education must not be content to teach political science; it must develop and promulgate a science of government that inspires statesmanship and not political expediency.

Higher education must not only define civilization and the role of government and politics in maintaining civilization, but it must redefine the practical objectives of a good civilization to which government and education may address themselves. We are here combining the forces of education and government. For too long education has attempted to separate itself

from government, but in view of the kind of world we have developed, this would seem to be no longer a desirable dichotomy. To unite the forces of government and education would strengthen both government and education. It would then be the function of education to define the objectives of a good civilization and the function of government and education in achieving these objectives.

The practical objectives of a good civilization fall naturally into three categories as follows: (*a*) those having to do with international relations; (*b*) those having to do with internal relations in a democratic society and with community relations within such a society; and (*c*) those having to do with human nature and human personality as they impregnate the whole. Among the practical objectives of a good civilization having to do with international relations, the following are prominent: to maintain international peace and good will; to share industrial advantages and scientific achievements with other nations less favored than ourselves; to develop greater international understanding; to show how nations might live in one world without war, or in two worlds if Willkie's "One World" is not obtainable; to prevent the depletion of the world's natural resources and to restore the "plundered planet"; to focus world attention on results that must follow from present national and international policies; to demilitarize the world; and to perfect some kind of a federation of authorities for the purpose of developing a plan and procedure for uniting the cultures of the world.

Among the practical objectives of a good civilization having to do with internal and community relations, the following may well be considered: to develop and to perpetuate the freedoms of democracy; to promote economic well-being; to help education to help itself; to maintain freedom from pressure groups, including political interference; to defend democracy and private initiative from the encroachment of communism; to learn how to use our expanding industrial economy without destroying individual rights and privileges and without becoming regimented and state dominated; to continue the expansion of our national income and its use for the accomplishment of higher standards of living, the further advancement of culture, and other values; to accept the facts of history for what they are worth as examples of past success or failure; to show how atomic energy and other contributions of science may be used for improving the way of life for the mass of mankind; to show how we may further advance our knowledge of science in order that we may increase our chance of survival if attacked; to encourage the development of public character as a bulwark against its further disintegration; to strike a judicious balance between change and the *status quo;* to teach men to take the long view rather than to be everlastingly absorbed by the things of the moment; to give to educational institutions the effective means of education now used largely for commercial profits such as movies, radio, television, and newspapers; to substitute reliable information and reason for emotional appeal as a basis for popular opinion and popular allegiance; to promote "cultural pluralism" as one aspect of a wholesome culture and to affirm it against totalitarianism and cultural fragmentation; to promote democracy through education; and to give our people a world view.

Practical Objectives

Among the practical objectives of a good civilization having to do with human nature and human personality, the following may be included: to develop human nature through education; to develop a positive and creative leadership; to help people adjust themselves to a rapidly changing world; to dispel hazy thinking; to develop the concept of unselfishness; to denounce mediocrity; to discourage lachrymose pessimism; to encourage assumption of responsibility to teach recognition and analysis of problems; to discourage men and women from being obsessed with the obvious; to discourage men and women

from believing absurdities; to develop social outlook and personal insight; to show how individuals may find a satisfying life without doing injury to others; and to prevent a sense of futility and a feeling that we are at the mercy of forces beyond our control.

The foregoing are a few of the desirable practices of a good civilization which should be clearly defined and set before the world by the forces of education as practical objectives of a good society. It will be possible in this brief discussion to enlarge upon only a few of these areas of human endeavor for illustrative purposes.

It is the function of higher education to invade more effectively the field of international relations; to address itself as vigorously to the problems of the world as they bear upon the relationship of nations, as the nations of the world are pursuing through noneducational means their own nationalistic tendencies and their own vested interests. Thus far in the development of world civilization, international relations have not brought peace upon the earth. The best minds of the country must address themselves to the problems of effective relationships between nations in order to give some promise of security to the human race. The American Council's publication *The Role of Colleges and Universities in International Understanding* is a remarkably comprehensive and detailed statement of the many opportunities and responsibilities of colleges and universities in this field.

This field of endeavor may be illustrated by reference to our loss of the friendship of Asia and our need for restoring that friendship. In the past the people of Asia, especially the Chinese, have, on the whole, trusted and admired the people of the United States. It is therefore painful to witness the turning away of our Chinese friends, the distrust of India, and the outright hatred of the North Koreans. As most of the people of the world live in Asia, it will be impossible for America as we know it to survive if Russia wins the contest between communism and democracy. If the Korean War can be brought under control, the United States should use every means within its powers to allay the fears of what Asiatics call American imperialism and to remove the causes of frustration. Asia considers that it has had bad treatment from what it refers to as imperialistic nations, with whom we are associated in the eyes of every Asiatic. The average American finds imperialism distasteful and our government and our education should more clearly express the feelings of the average American on this point than they do at the present time.

The frustration of the people of Asia is an urgent problem. These people are frustrated because they are desperately poor, because the white man has made them feel inferior. This point of view was brought out in the third yearbook of the Society for the Psychological Study of Social Issues in 1945 at the close of World War II. The report predicted fairly accurately what is now happening in Asia. It said in so many curiously combined words that the hazards that face us in the coming decades will not be hazards resulting from the frustrated peoples of the world, but from the frustrated peoples of the world being surrounded by populations with psychologically rich traditions as regards war, and with none of the groups possessing a unified and clear machinery for the maintenance of peace.

Perhaps the answer to this problem is that we should listen more carefully to our social scientists and less to the politicians of the world. Reflection upon our own history in relation to Europe should furnish a perspective in which we could appreciate better the sensibilities of those emerging from colonial domination. We need to make an unprecedented and heretofore undreamed-of effort to dissociate ourselves from the policies and practices discredited by history. It is the role of higher education to discover and to seek to implement these new ways in dealings between ourselves and the peoples of Asia.

Human Equation

Since some of the practical objectives of a good civilization are to be found in areas now served in a traditional way by higher education, a few references to some of these areas might be helpful in defining the new role of higher education in the new world. For example, higher education must review the function of science and engineering and their relationship to the human family. The true functions of science and engineering, apart from their functions of gaining knowledge and understanding, is to make the world a happier place in which to live, a better place in which to live, and a more convenient place in which to live. They must relate themselves more closely to the human equation and consider their effect upon the minds and souls of men.

An entirely different type of objective for higher education is suggested by the word "vocation." Higher education has always been concerned with the vocations that men and women follow. It is desirable in these times to call upon education to review the whole problem of the role of man in carrying on the work of the world as related to his role as a social being. Vocationally minded men and women have departed from the Emersonian theory of man to the effect that when man was created he was not only divided into men that he might carry on the work of the world, but that it was his responsibility upon returning from his job of doing the world's work to give his attention to the problems of serving his fellowmen. One's vocation can no longer be considered as an end in itself, but as a means of contributing to the welfare of mankind. The great professions and the professional schools have social obligations that are as compelling as those implied in the objectives of general education.

It follows that if higher education is to review the areas of life commonly reserved to politics and government, international relations, science and engineering, and vocations, it must give its attention to the whole problem of the social sciences and the needs of the common man. Higher education must raise the question of the ends to be served in politics and government, international relations, science and engineering, and vocations. Ordinary courses in sociology are not sufficient. Higher education must address itself to analyzing the needs of mankind that are to be served by the activities of leaders in all walks of life.

Just as surely as we raise the question of the social sciences and their relationship to other services performed by the leaders of our society, we raise the fundamental question of the moral, ethical, and spiritual disintegration of our society. We seem to have lost our sense of values. We find the disintegration of personal character in every phase of modern life. A simple course in ethics in our colleges and universities will not do the job. The problem must be approached on a broad front by all of the forces of higher education in this country.

The crisis in character deserves further analysis. There seems to be little doubt that the greatest problem facing education and the world today is ethical or moral in character rather than intellectual or political. We have made such rapid strides in scientific studies and intellectual pursuits that we have not only got rid of most of our superstitions but we may be on our way to losing a great deal of our faith. In this connection, Arnold Toynbee has been an outstanding spokesman. This historian believes that nations and cultures thrive and advance in direct proportion to the degree of loyalty they maintain to spiritual principles. He also believes that ours is a tottering civilization which "has shamefully succumbed to the intoxication of a showy victory over physical nature, and has applied the spoils to laying up treasures for itself without being rich towards God." Professor Ralph Gabriel, after an objective study of American democratic thought since 1815, says: "The basic postulate of the democratic faith affirmed that God, the Creator of man, has also created a moral law for his government and has endowed him with a

conscience with which to apprehend it. Underneath and supporting human society, as the basic rock supports the hills, is a moral order which is the abiding place of the eternal principles of truth and righteousness."

The recent national scandals of various sorts have focused attention sharply upon our failure inhigher education to inculcate moral and spiritual principles. The pragmatic policy of decrying all absolute values in looking upon right or wrong simply in the context of what works in a given situation is under sharp attack. If our American education is grounded upon such foundations, it and our civilization are "dead ducks," as Toynbee has so aptly said.

Character is Learned

Higher education must recognize the fact that character is learned and the learner acquires special characteristics from his experiences. If it is true that character is learned, and if it is true, as seems unfortunately to be the case, that there is a disintegration of personal integrity in our society, then it follows that the remedy lies, to some extent at least, in the field of education. In this connection, we do not believe that character can be based upon human personality alone as Walter Stace, at the Mid-Century Convocation on the Social Implications of Scientific Progress, held at the Massachusetts Institute of Technology, seemed to contend. He said in a panel discussing science and faith: "My thesis is that morals were formerly believed to be based on supernatural or metaphysical foundations. This belief is disappearing so that morals seem to have no foundation. This has produced a crisis in the human spirit, also of moral faith. But this is all based on a mistake. Morals have a perfectly firm and objective foundation in human personality. If man can be brought to understand this, then moral faith may be restored. The problem is really one of education." We do not believe that education has to ignore the traditional religious basis for character development.

Higher education cannot invade the area of value-judgments and undertake to restore the integrity of mankind without undertaking to analyze and solve the whole problem of criminology. The legal approach to the solution of the problem of crime has failed. All our courts of justice, all our penal institutions, and all our education have not halted the disposition of a large segment of our population to engage in criminal acts of every conceivable kind. Again, a course in criminology is not the solution. There must be a concerted effort on the part of higher education to deal with this problem in an intelligent and constructive way.

Higher education must invade the realm of religion, and strengthen religion in its efforts to make the world a better place in which to live. A transmission of our great spiritual heritage has not taken place. Generation after generation of school children and those in higher education are receiving only the most cursory treatment of the whole subject of moral, ethical, and spiritual values. Our failure to transmit the spiritual heritage of our people is due in large measure to the confusion which we have experienced as regards the meaning of the separation of church and state in our schools. We have interpreted this to mean the separation of school and religion, and the result of this has been that a teacher, at state expense, can espouse the cause of any philosopher or theorist, can indeed attack organized religion, but he cannot in the line of duty openly support a religion, or religious ideas especially, without subjecting himself to censure and without making the school subject to legal action to stop the teacher from so expressing himself. This confusion has in part contributed to the moral and ethical illiteracy of our generation, as evidenced by what takes place in government, business, and the professions beginning at Washington and extending to the outermost parts of the land.

Higher education must also give greater attention to the arts and to the finer expressions of the human mind and the human soul. The mind of man must be

conditioned to love the finer things of life. This can come about only as our leaders, who are conditioned in our institutions, have the proper appreciation and love for the artistic and aesthetic expressions of man.

As we invite colleges and universities to invade the whole realm of moral, ethical, and spiritual values, the wars which we have fought and which we are fighting today take on a different meaning, and it is not an insignificant observation that colleges and universities have been at war ever since the beginning of the Second World War. They are still training our officer personnel and working in their laboratories on the most destructive weapons to wage war ever conceived by man. These activities seem to be necessary, but one of the great problems of the next decade is how we can save the soul of higher education while thus engaged.

Mental Health

As we have observed, many of the practical objectives of a good civilization have to do with human nature and human personality. Moreover, many of them have to do with the attitudes of men and women and the poise and tranquillity by which they deal with the crises of our modern civilization. Therefore, we believe that higher education must invade the whole field of mental health and help the people of our country and world to obtain an orientation to the difficult times in which we live. The needs of mankind in this realm are demonstrated by the tremendous sale of books, written in many cases by relatively incompetent people, which hold some promise of giving mankind the peace of mind that it seeks. The minds and souls of men are weary, uneasy, and frightened; and they seek comfort and tranquillity. If higher education is to make its contribution to the solution of these problems, it must release itself from its moorings, extend its field of effort and make its contribution to the solution of the problems of the human mind. Again we contend that courses of study alone will not solve these problems. It will take the concerted efforts of the best minds of our day and generation. Not all of these minds, but many of them, are to be found in the field of higher education. This great human potentiality must be unleashed and directed toward the solution of our common problems.

In this brief paper on the problems of the next decade and the functions of higher education in helping to solve those problems, we have dealt with higher education in a thoroughly unorthodox way. In our opening paragraphs we attempted to set the stage for such a discussion by placing certain limitations on our analysis of the problems and the possible solutions to them. We dismissed the orthodox and traditional functions of higher education in order that we might give serious attention to the new role of higher education in the years that lie immediately ahead. In dealing with this new role of higher education, we assumed for it a vigor and healthy-mindedness that seems to be necessary if it is to perform its true function in the decade of the 1950's.

We ventured to assert that the primary function of higher education in the next decade is to redefine what we mean by a desirable civilization, and to defend that civilization intelligently against the encroachment of other so-called civilizations which have resulted in the social tensions of the world. We advanced the conviction that it is not only the role of higher education to define and defend a good civilization but to define the practical objectives of such a civilization in order that all the forces of democracy might combine in an effort to accomplish these objectives. Our justification for calling upon higher education to render these services is that the times in which we live are unusual times. Dangers lie all around us. The disintegration and even the destruction of mankind are not an impossibility. Whether or not we save our world may well depend upon many things but certainly the contributions of higher education during the next decade will be significant.

How higher education is to perform its significant role is a difficult question to answer. When one realizes the modest intellectual and scholarly equipment which most young people bring to college and how much time all of us, teachers and students, have to devote to keeping abreast of current responsibilities, we realize how little time and effort we can devote to looking ahead. Are we, therefore, merely engaging in a kind of wishfulness? We think not. There is still, we believe, an unused increment in our colleges involving individual teachers, research scholars, and students, that can be marshaled for some of the responsibilities we have outlined.

Our Task

First, we can set ourselves the task of understanding the problems of the next decade. Such an understanding would make the entire educational process more meaningful. Moreover, we can join hands with teachers, research scholars, and students throughout the world in a concerted effort to develop ways and means of solving our common problems. Finally, we can come out of our ivory towers and join hands with government and men of affairs to the end that all of the forces of democracy may be unified in the common task of creating and defending what we have referred to throughout these pages as a desirable civilization.

College Industry Conference

About 500 representatives from New England colleges and industry attended the fourth College-Industry Conference, sponsored by the Relations with Industry Division of the American Society for Engineering Education, at the Massachusetts Institute of Technology.

The conference theme was "The Engineer as an Individual." Opening addresses were given by Dr. Karl T. Compton, Chairman of the Corporation of M.I.T., and Dean S. C. Hollister of Cornell University, who is President of the American Society for Engineering Education.

Principal addresses of the morning session were given by Morris Meister, who discussed the secondary school aspects of the engineer's training; Jess H. Davis, President of Stevens Institute of Technology, who discussed the college aspects of the engineer's training; and H. N. Muller, who discussed the engineer's industrial training in his first year out of college.

The afternoon session of the conference was devoted to three simultaneous panel discussions centered on the themes of the morning talks. Moderators for the panel groups were K. B. McEachron, Jr., Ralph A. Galbraith, and J. C. McKeon.

Development and Utilization of Engineering Talent*

By J. C. McKEON

Manager, University Relations, Westinghouse Electric Corporation

Training and proper utilization of the limited supply of scientific and engineering personnel is the most critical problem facing our nation. The defense of our way of life and the re-establishment of any semblance of peace demand that we, as a nation, become strong economically and militarily—and remain strong. We must maintain a commanding lead in pure scientific research, engineering developments, and industrial production. Such a tremendous undertaking requires trained personnel. The cold fact is we do not and will not, in the foreseeable future, have enough technically-trained men to meet industry and military needs.

Utilization of Technical Manpower

Members of ASEE are fully aware of the engineering manpower crisis. President Hollister's studies urge the establishment of sound policies to allocate available technical manpower to industry and the military, to utilize talent effectively, as well as to encourage qualified high school students to enter engineering. The members are also familiar with the steps being taken by this Society, E.J.C., and other professional groups to bring the need for action to the attention of policy makers in industry, government, and the general public. The progress of these organizations is well-known to each of you.

The manpower crisis challenges each of us as individuals. For in the last analysis, this problem must be solved by the management of each company. True, the solution, in part, lies in the establishment of sound national policies. However, while organized groups are working at the national level, we must make sure we are doing everything possible to meet the situation in our own organizations. In the critical days which lie ahead, greater emphasis must be placed on the responsibilities of the individual units employing engineers.

Although there are many aspects of the manpower problem, I shall confine my discussion to the development and effective utilization of technically-trained men within a company. The first step toward a constructive personnel development policy is the realization that your company will be unable to secure all the technical manpower required, either through the recruitment of young engineers and scientists from the colleges, or by the employment of experienced men from other companies. Although management recognizes the problem, generally, the tendency is to think in terms of the shortage affecting the other company and that somehow your company will get all the technically-trained men it needs. Facts do not justify such optimism.

The second step is acquiring an appreciation of the value of a personnel development program. Productivity per engineer can be increased through effective training and personnel development.

* Presented at the Winter Meeting of the American Society for Engineering Education, Middle Atlantic Section, Newark College of Engineering, December 1, 1951.

The experience of enlightened organizations has demonstrated the value of well-planned programs. Proper job placement, higher level of technical competence, better supervision, greater job satisfaction spell higher productivity.

Moreover, an effective development plan gives assurance that the individual skills will be used to the best advantage. A properly managed program aims, not only to find and develop talent, but to use the native and acquired skills. This objective is accomplished by employing the young engineer's present abilities at the highest possible level and, at the same time, develop his technical and social skills for positions of enlarged responsibility. To meet the impending crisis, the top management of every industrial organization must vigorously support an integrated personnel development program. In some companies it means the inauguration of a new plan; in others, the realignment of existing programs and filling-in the gaps is all that is required. Few companies, if any, can rest on their laurels and remain in business during the next quarter century.

Having recognized the manpower problem and being convinced of the value of personnel development, we are ready to translate our ideas into a program of positive action. This brings up the question—what type of program should be established? The answer depends upon the nature of the company. The type of goods produced or services rendered, channels through which goods or services are marketed, geographical location, labor conditions, past experience with training programs, calibre of present supervision, and management philosophy are factors to be considered. In most organizations, it is advisable to introduce the program in steps, particularly in companies in which the first line supervision is not training-conscious. The transition in such organizations should be gradual.

Irrespective of the foregoing variables, there are a number of training and educational areas a program should embrace. For a picture of what I have in mind, I will highlight the essential features of a program for professional people which has proved successful in the organization with which I am associated. Perhaps our experience can serve as a point of reference for companies interested in blueprinting their own professional development plan.

A Personnel Development Program

Early in the history of the company, through the efforts of George Westinghouse and B. G. Lamme, a program for the recruitment and development of engineering graduates was inaugurated. This program has been consistently appraised and adjusted to meet changing conditions. Its primary objective is to develop competent people for all technical and management positions in the company. Nothing is more fundamentally vital to the future of our company than a sound personnel development program. Emphasis is placed on the development of broad, professional attitudes as well as technical competence. Our personnel development program consists of a number of individual programs, which may be described as a Six Point Plan.

I. *Selection and Recruitment*

The first step in building and maintaining our organization is the recruitment of capable people. The great majority of technical and professional personnel of Westinghouse is recruited at the colleges. It is not only important to have a flow of new blood into the organization, but it must be the right type. Careful screening of candidates from the standpoint of technical ability and personal qualities is considered essential. Ineffectual selection not only results in the employment of misfits who prove costly in terms of turnover and employe dissatisfaction, but deprives the company of good men who will be needed in the future. Men recruited at the colleges for positions on the first rung of the professional ladder are selected for their potential rather than their ability to become fully productive immediately.

II. *Initial Training*

The objectives of the Graduate Student Course, our initial training program, are to give the recent college graduate an understanding of the company's organization and the diversified activities open to him; to teach him methods of applying fundamental principles to the solution of industrial problems; and to assist him in finding the right type of work in line with his aptitudes, interests, and educational background.

These objectives are accomplished through a series of coordinated work assignments, technical and professional conferences, and individual counseling. In brief, the program is a process of matching men and jobs and providing each man with the tools to move forward. It is a system in which the individual plays a leading role in determining the nature of his career.

III. *Follow-up Training*

Continuous training on an informal basis is essential to the maximum development of a young engineer. Upon placement in a department, he is assigned to a senior engineer, who understands the problems confronting a new man. A sympathetic approach does much to bring out the good qualities and remedy shortcomings.

As the young engineer gets a "feel" of the work, he is encouraged to assume responsibility as fast as he can handle it. Flexibility in arranging jobs makes possible the use of the individual's abilities at the highest level. Job rotation broadens his knowledge, and prepares him for advancement along technical or supervisory lines.

IV. *Continued Education*

Continued education is an integral part of the Westinghouse development plan. Professional employes are urged to include both formal and informal education in their own self-improvement program. Supplementing undergraduate education with additional study is of particular value to a young engineer. It broadens his background, keeps him mentally alert, and provides a foundation for professional growth. Educational pursuits also give a sense of personal accomplishment.

The Graduate Study Program, affiliated with ten universities, offers unusual opportunities to combine graduate work with the regular job. A majority of the graduate-level courses are offered in the late afternoon or evening, although the well-known Design Schools, started by B. G. Lamme in 1912, are daytime programs. The fields of study include mathematics, science, engineering, and business administration. Our engineers are encouraged to avail themselves of classes in business management, the social sciences, and the humanities, as well as technical courses. The company pays a substantial part of the tuition costs.

V. *Professional Activities*

Participation in engineering societies and civic organizations does much to develop the well-rounded individual required in our organization. Contacts with people with different backgrounds and interests broaden the young engineer's viewpoint. All technical graduates are urged to continue their engineering society affiliation. Committee work engenders a sense of belonging and promotes a professional consciousness. The preparation and presentation of papers build self-confidence and give the young engineer recognition in the company and throughout the profession. Management sets the example by actively supporting the societies.

VI. *Management Development*

The management talent search is a must for every company. Under our Six Point Plan, we do not have to start from scratch to develop executive leadership. The program outlined in the foregoing paragraphs provides the foundation and brings potential leaders to the attention of management. Our point VI, therefore, concerns itself with grooming men of demonstrated ability for positions of increased management responsibility.

Development at this level is, by necessity, individualized. An engineer normally becomes a "specialist." To manage capably on the higher levels, he must be a "generalist." Through horizontal promotion, special tours of duty, and leadership training conferences, broad-gauge managers are developed. Decentralization of operations and the "divisional type" of organization contribute to the development of competent executives.

The Six Point Plan is fundamentally sound. Its basic principles are applicable to any company, large or small, although the details of operation and methods employed must be tailored to fit the individual company.

Meeting Individual Needs

The comprehensive program I have outlined gives careful consideration to the development of personal qualities essential to success. Here we are dealing with intangibles which at once pose the most perplexing and at the same time the most challenging questions in personnel management. Although people do not differ from one another much, the small differences are of great significance. Success in integrating this human equation is difficult to measure. Nevertheless, in its efforts to increase the technical competence and industrial "know-how" of the college graduate, management must be mindful of the value of personal development for professional responsibility.

When we employ a college graduate, we do not hire mechanical skill or analytical ability alone. Instead, we hire an individual with many personality traits, all of which have a bearing on his performance on a job. As an individual, the employe does not park his human equipment at the shop gate when he reports for work each morning. He brings with him his hopes and his fears, his good qualities and his bad traits; they are all a part of him. His home life and adjustment in the community influence his work, and the conditions of work, in turn, affect his family relations. A live, moving organization cannot be built without due regard for the needs of the individual members of the industrial team.

The points I have just raised may seem, to some people, far removed from our discussion on industrial production and the shortage of engineers and scientists. Indeed, they are very close. Motivation, pride of workmanship, and high morale are the keys to productivity. Attitudes are significantly related to the individual's response to the industrial situation. Development programs must have high ideals which inspire the individual as well as objectives which are immediate and practical.

The development and utilization of engineering talent cannot be left to chance. It must be carefully planned. To effect a program, top management must, first, establish a clear-cut policy concerning the development of professional personnel. This policy must then be implemented, through a program which provides the machinery, to accomplish the desired objectives. An organized program not only provides the means of finding and developing particularly talented men, but it raises the general level of professional competence throughout the organization.

Whether we as a nation experience a series of Koreas, all out war, or a period of uncertain peace, we must maintain a state of total preparedness. Failure to educate, train, and properly utilize our greatest asset—potential leaders—would be national suicide.

As individuals, and as members of a profession, each of us must assume a full measure of responsibility in the establishment of sound policies for the conservation of professional talent.

Engineering English: A New Strategy

By RICHARD B. VOWLES

Assistant Professor of English, University of Florida

There are always a few engineers who find the English language both disquieting and alien. They take cold comfort in the admission of such a professional writer as Arthur Kober that the composition of a simple declarative sentence is plain torture. They may console themselves that if you have an idea words won't stand in your way; but they know better. Despite a spate of books on technical English and report writing, which happily indicate that the engineer is of all professional men most conscious of the need for accurate communication, alienation still exists between the engineer and his language. Now it is largely up to the colleges of engineering to turn this armed truce into an amiable partnership.

The University of Florida is at present experimenting with a program of technical English that may well be novel and is certainly an unusually flexible strategy. It is based on four fundamental assumptions, that

(1) the language is part of the engineer's know-how,
(2) technical English ought to be taught by technical men,
(3) it ought to be taught in the engineer's bailiwick, and
(4) it ought, so far as possible, to be integrated into existent courses.

Ideally, such a program should overcome any possible grudge the engineering student might harbor toward his language.

The English staff in engineering presently consists of two Ph.D.'s (in English): an assistant professor with a background of chemistry and chemical engineering (8 hrs.); an instructor experienced in petroleum engineering (4 hrs.); and a graduate assistant (10 hrs.). They constitute a kind of roving team, if you like; their essential function is trouble-shooting. Their dual qualification eliminates any taint of that condescension which sometimes makes the man of arts *persona non grata* in a sciences building. And well it is that sympathetic cooperation should be complete, since the college of engineering at Florida is motivating the program and supplying budgetary allotment to it.

Special Services to Engineering Departments

Each department avails itself of this service in its special way. Civil engineering incorporates a series of four lectures on basic writing problems into a seminar on engineering literature. Industrial engineering prefers to have a member of the English team spot-check a set of papers from time to time, in which case a fraction of the grade is a writing proficiency score. Chemical engineering employs what is possibly the most interesting technique. Sets of laboratory reports are intermittently turned over to the English staff for correction in matters of diction, syntax, and structure, before being graded by the professor in charge of the course. Individual conferences are later held with each student *during* the laboratory hour. Consequently the intrusion is minimized and the young engineer learns to consider his language problems in the context of plant and laboratory practice.

In addition, the English staff offers what it likes to call a kind of consultant

service. Students in the throes of a seminar report are invited to bring their problems to the staff quarters in the engineering library. If they are unable to get any life into that first letter of application, they are offered advice. Thus, *the* report or *the* letter is made a "nuclear" situation, as latterday jargonists might put it. It is *realistic.*

In short, the engineer is not asked to write the series of artificial letters, papers, and reports that the traditional course in Technical Report Writing heaps on what is so often an overloaded schedule. Furthermore, the report is not isolated from its functional relationship to engineering practice. We hope, here at Florida, that the technical elective in report writing will be obviated by this fluid program which is now operative experimentally.

Screening Test

Such a plan as this might result in a fragmentary picture of writing skill. To prevent this and to permit an early stocktaking of material, the entire junior class of engineers is given a screening test upon entrance into the upper college. During a 1½ hour period the student is required to proof a passage of semi-technical prose and to write on one of a number of controversial passages of scientific import. Each student, no matter what his performance on the test, then has a brief conference with a member of the English staff who acquaints him with the English program and indicates how it may offer effective remedy to some of his problems.

Those students deficient in English are required by their departments to attend a refresher course, not unlike what is usually and unfortunately called "remedial" English. Attention is given to the fundamentals of English in a thoroughly traditional way, except that the slant is technical and every possible use is made of the scientific analogy. For example, L. O. Guthrie's designation of the verb as the "energy center" has been found useful in a discussion of the elementary design of a sentence,[1] and other strategies of the communications course are employed. Such method is surely not pandering to the specialized mind, but wise approach to poor students who, since high school days, have been building up a hard core of resistance to their language. So far, mimeographed materials drawn from student writing and scientific journals have been used in place of a standard text. At present, no more than one month of the course is required; from that point on attendance is voluntary. The theory is that on which most reading and speech clinics operate, that enforced attendance over a period of time militates against cooperative effort, at least in such non-credit activity. This course is, however, still in a state of experimental flux.

Our program, in its entirety, is part of the upper college. It has no bearing on the freshman course, where the engineer gets exactly the same instruction as the next man. Certainly it is far from our design to give him the feeling he is especially privileged or especially retarded in his language training.

Make Language Conscious

Finally, it might be observed that the benefit of the Florida program lies not in dressing up any single technical report or in dressing down any particular student, for his faulty style. It lies, instead, in making the entire engineering school language-conscious, and in improving the texture and tonus of engineering writing. The engineering faculty have shown admirable foresight in activating a program which may, if successful, spread to other divisions of the University and may even, as a trial run, create wider interest. It is still too early to evaluate the plan in terms of teaching hours and profit and loss, but by way of interim report we might predict a modest success. The Florida plan has the strategic value of being *less intrusive* and at the same time *more pervasive* than the traditional approach.

[1] *Factual Communication* (New York: Macmillan, 1949), 212.

How Can ASEE Assist the Young Instructor?*

By HENRY H. ARMSBY

Associate Chief for Engineering Education, U. S. Office of Education

In a paper before the Southwest Section of ASEE in April 1949, a condensed version of which is scheduled for publication at an early date in the *Journal of Engineering Education*, your speaker outlined some methods by which the colleges and universities can help young instructors to grow and develop professionally. Other papers on today's program have been devoted to the problems of the young instructor in learning how to teach, and to a discussion of teaching techniques. In this paper it is proposed to discuss some of the ways in which ASEE as a Society can assist the young instructor to achieve his full professional stature.

Need for Professional Development

This discussion is based upon the assumption that the young instructor we are discussing is in the teaching business because he wants to be, and that he, like other young men, desires to make good in his chosen profession. He aspires to be the professor, the department chairman, the division director, or in some cases the dean or the college president of tomorrow, just as his classmate in industry aspires to be the chief engineer, the general superintendent, or in some cases the manager or the company president of tomorrow. Of course, not all of our young instructors will become deans, nor will all of our young engineers in industry become general superintendents. Those who reach these high positions will do so because they have grown, not merely in age, but in variety of experience, breadth of knowledge and vision, in ability to accept and to discharge responsibility, in awareness of civic duties, and the desire to help younger men. In other words, either avenue of promotion depends on professional growth.

There is widespread recognition of the need in industry for the engineer to understand not merely scientific principles and their practical applications, but also the social, economic, and political implications of his work. This recognition has been exemplified by the Interprofessions Conference on Education for Professional Responsibilities at Buck Hill Falls, Pennsylvania, in 1947, and by the findings of the Engineers' Joint Council and the Engineers' Council for Professional Development.

The successful *engineering teacher* must also develop professionally, not only as an engineer but as a leader of men, who can instill in his students a spirit of scholarship and a desire to develop themselves to the limit of their individual capacities. Furthermore, the good teacher must give to his students knowledge of how they may proceed most effectively with their own development. The primary responsibility for increasing his competence as a teacher rests, of course, on the teacher himself, but his institution and his professional colleagues are in a position to do a great deal to assist him in planning his self-development, and even in carrying it out. They should make it clear to him that he is *expected* to grow and to develop, and should give him opportunities to do so by properly orienting him to his work, by

* Paper presented before New England Section, American Society for Engineering Education, October 14, 1950.

enabling him to do post-graduate study, and by encouraging and assisting him to gain both teaching skill and industrial and research experience, the objective of which should be to improve his knowledge and broaden his interests, rather than merely to increase his income.

The Purposes and Values of ASEE

The young engineering instructor's professional colleagues as a group are represented by the American Society for Engineering Education, a Society organized with the fundamental purpose of "the advancement of education in all its functions which pertain to engineering and allied branches of science and technology, including the processes of teaching and learning, research, extension services, and public relations." Its Constitution sets forth that the Society "shall serve its members as a common agency of stimulation and guidance in . . . the development of effective teachers and administrators, the improvement of instructional materials and methods, of personnel practices, and of administrative usages, the enhancement of professional ideals and standards, . . . and the cultivation of a fraternal spirit among teachers, administrators, investigators, practitioners, and industrialists." These are high ideals indeed and any society which can even partially realize them can feel that it is making a most worth-while contribution to the welfare of its members.

Nothing is quite so valuable to the beginner in any profession as the inspiration he can secure by close contact with the leaders of his profession. Also, nothing contributes quite so much to his advancement as the opportunity to become known to these leaders, to show them his abilities, and to make himself useful to them. For the engineering teacher, there is no way in which these objectives can be achieved better than by active participation in the work of the American Society for Engineering Education, by attendance at meetings, by joining in discussions, by preparation and presentation of papers, by service on committees, by holding office, and in general by furthering the aims and objectives of the Society. He can thus make himself known to the leaders of his profession and can be developing his own abilities in an extremely practical way. As in most human activities, the benefits he derives from ASEE well depend quite largely on the amount of effort he expends.

The Young Instructor in ASEE

In general, the instructor should start by making himself useful to his Branch if there is one in his institution, and to the Section in which his institution is situated. He has a much better opportunity to make himself known in these smaller groups than he would have by starting directly in the national group. If he earns a reputation for clear thinking, for ability to express himself well, for willingness and ability to do committee work and to hold office in the Section, he may rest assured that he will attract the attention of the national officers of the Society, and that his talents will be put to work for the benefit of the national Society, which will contribute greatly to his own professional growth. Many college administrations realize this and encourage participation in the affairs of ASEE and of the professional engineering societies. The amount and character of the teacher's participation in such affairs is frequently given consideration in making staff promotions. Of course it is understood that such activities should not be looked on as a substitute for doing committee work and otherwise cooperating with his campus colleagues.

ASEE is organized in such a way that the individual member has direct and easy access to the officers and the General Council, who administer the affairs of the Society. He is represented in two ways on the General Council, first, by a Council member chosen to represent the geographical section in which his institution is situated, and second, by another Council member chosen to represent the subject matter division of the Society with which he is affiliated. The General Council

also includes the three immediate past Presidents and the Executive Board, consisting of the Society's national officers. The Executive Board carries on the general activities of the Society between meetings of the General Council, and regularly performs certain functions which are delegated to it by the General Council.

Each member institution of the Society has a representative on the Administrative Council of the Society, and each institution which is actively engaged in engineering research has a representative on the Research Council. The chairmen of these two councils are ex officio vice-presidents of the national Society, and therefore members of the General Council and the Executive Board. This democratic form of organization makes it possible for teachers of any academic rank to become officers of the Society, members of the General Council, or officers of Divisions, Sections, or Branches.

Any member can offer a paper for presentation at the annual meeting or at a Section, Branch, or Division meeting, by merely sending a copy of his paper to the chairman of the Division, Branch, or Section concerned, many of whom rely on voluntary contributions in formulating programs. In addition to this, any member may submit a paper to the publication committee of the Society for publication in the *Journal of Engineering Education* regardless of whether or not the paper has been presented at a formal Society meeting.

How ASEE Now Helps the Young Instructor

The *Journal of Engineering Education*, the official publication of ASEE, constitutes a veritable storehouse of useful and inspiring articles about various aspects of engineering education. The young instructor might well be a "cover-to-cover" reader of this journal, since even articles about some other phase of engineering education than the one in which he is particularly interested contain valuable suggstions which the young instructor can utilize in his own classes. An outstanding example is found in the article entitled "Interdepartmental Cooperation for Better English" in the June 1950 issue, in which Professor Mack of Lehigh University outlines the methods used in his institution in an organized effort to have every teacher actually *do something* about improving the quality of English used by his students. Any young instructor who reads this article should be inspired by it, and many will probably wish to adopt some of the methods discussed. Furthermore, the idea of interdepartmental cooperation which is set forth in this article has valuable implications for other parts of the engineering curriculum as well as for the courses in English.

The Society has published a "Manual of Effective Teaching," which was prepared by a Society committee. This Manual contains many valuable suggestions which will greatly assist the young instructor in organizing his work, in planning his courses, and in self-evaluation of his effectiveness as a teacher.

The Society each summer sponsors one or more summer schools for engineering teachers. Each summer school is sponsored by one of the subject-matter divisions of the Society, and is devoted to lectures, discussions, and exercises looking toward the improvement of the teaching of that particular part of the engineering curriculum. The primary emphasis of these summer schools is on the development of the teacher, and in general technical engineering papers are avoided.

Since April of 1949 ASEE has had a national Committee for Young Engineering Teachers, under the chairmanship of Professor F. L. Schwartz of the University of Michigan. This committee was appointed because of a feeling on the part of many that there was a need for some mechanism by which the younger members of the Society could find more direct assistance, expression, and responsibility in the advancement of themselves and of the Society. The committee has defined its objectives as:

A. An understanding of the general goals and responsibilities of the *two* professions which every teacher of engineering follows, engineering and education.
B. Orientation into the history, the lore and the "unwritten laws" of the dual profession of engineering education.
C. An acquaintance with the most effective instructional materials and methods, with methods of evaluating student achievement, and with the elements of counseling and student guidance.
D. Guidance in his personal professional development both as an engineer and as a teacher.
E. A means of exchanging ideas with his contemporaries.
F. Stimulation.
G. Dissemination of knowledge.

Two meetings of younger teachers were held in connection with the 1950 annual meeting of the Society in Seattle. Professor Schwartz has suggested that if sufficient interest develops among the younger teachers the group may at some future date apply for Division status in the Society.

ASEE now has a Committee on the Improvement of Teaching under the chairmanship of Vice President Grinter. It is hoped this Committee will develop some definite, concrete, and worth-while procedures which the Society can use and endorse toward this end. The Society has also been asked to name participants in a national conference on the improvement of college teaching, which is being organized jointly by the American Council on Education and the United States Office of Education.

There is no reason why a Section may not have similar committees, and other Sections might profitably follow the example of the National Capital Area Section in its annual meeting last spring. The theme of this meeting was "The Improvement of Engineering Teaching." Papers were delivered by the Dean of a College of Education, the head of a Department of Psychology, and a Training Specialist in the U. S. Navy Department who was formerly a Professor of Speech. These papers were all top-notch presentations and were followed by active discussion from the floor, in which many of the younger members of the Section participated. The members of the Section considered it a highly successful meeting, and felt that it served as an inspiration to all present to really try to *do something* about improving themselves as teachers. The paper by the Dean of Education has been sent to the publications committee of the national Society with a recommendation that it be published in the *Journal of Engineering Education.*

What More Can ASEE Do For the Young Instructor?

Some ways in which ASEE, both nationally and in the Sections, can still further help the young instructor might be suggested.

1. More local Branches could be established to serve as forums for both the younger and the older members of the profession, with special emphasis on stimulating younger instructors and broadening their horizons.

2. More summer schools for engineering teachers could be conducted, with major emphasis upon such subjects as teaching methods, teaching aids, evaluation of student achievement, teacher rating devices and methods, and evaluation of effective teaching.

3. National or local committees could prepare and circulate technical and cultural reading lists for young instructors.

4. Groups of young instructors might be encouraged to study the history of engineering.

5. National and sectional meetings might devote more time to discussions of the engineering teacher as a technical writer, as a consulting engineer, as an educational administrator, and of his relations with industry.

6. National and local committees might be appointed to study the implementation of the aims and objectives of the Society, stated in Article I of the Constitution as "the adjustment of curricula and educational processes to changing conditions," "the development of effective teachers and administrators," "the improvement of instructional materials and methods, of personal practices, and of administrative usages," "the coordination of institutional aims and programs," "the cultivation of a fraternal spirit among teachers, administrators, investigators, practitioners, and industrialists."

Most of these services *can* be rendered effectively by Sections and Branches of the Society as well as by the Society as a whole. If the Sections and Branches *will* render these services, especially to their younger members, they will strengthen not only the individual member but the national Society and the institutions it serves.

Conclusion

The American Society for Engineering Education is doing a great deal to assist the young instructor to attain true professional status. The Society can do more than it is now doing. It can be especially effective in the Sections and Branches because of closer and more intimate contacts. The ultimate effectiveness of the Society in helping young instructors will depend in the final analysis on how much the young instructors help the Society.

In the News

National Science Foundation Grants

The National Science Foundation has made travel grants to four American mathematicians to permit their attendance as members of the United States delegation to the First General Assembly of the International Mathematical Union in Rome, Italy, March 6–8, 1952. These are the first travel grants to be made under the Foundation's program to provide for the attendance of American scientists at international scientific meetings.

Russell S. Poor, Chairman of the University Relations Division of the Oak Ridge Institute of Nuclear Studies, has taken a year's leave of absence to join the National Science Foundation. Dr. Poor will head the Research Education Section of the Division of Scientific Personnel and Education of the NSF.

The National Science Foundation has announced approval of 28 research grants, totaling $410,000, in the field of the biological sciences. This is the initial group of grants which will be made under the Foundation's program for support of basic research in the sciences.

"Life is Short. We Need to Make it Broad"

By CLEMENT J. FREUND

Dean, College of Engineering, University of Detroit

The late and revered Robert Doherty had many trenchant things to say about engineering education. For example, "One of the greatest deficiencies of engineering courses in this country, in my opinion, has been the lack of cultural balance. Where such a balance has not existed the student's intellect has been literally starved for the vitamins of humane appreciation, thus leaving him with what might be called technical rickets —a wooden interest in things outside his technical field."

Whenever the chairman or the president, or even the chief engineer of any one of our great American corporations stands up to talk about engineering education, he pounds the table and insists that engineering education must be broad.

And we engineering educators eagerly nod approval. We read about the need for broad engineering education in the "Report of the Committee on Educational Survey" of the Massachusetts Institute of Technology; we read about it in the "Report of Committee on Engineering Education After the War," in the "Report of Committee on Aims and Scope of Engineering Education," and in the "Report of Investigation of Engineering Education." And we expect to read about it when Dean Hollister's new committee reports to the Engineers' Council for Professional Development. Everywhere, all the time, our thoughtful leaders talk to us about the necessity for broad education. And we say to ourselves, "I agree with them exactly, only they say it so much better than I could."

Practice What We Preach

But do we always "suit the action to the word"?

Observe a typical engineering dean. He has just returned to his office from a national engineering convention at New York or Washington or somewhere. In the course of his address at the convention he raised his arm on high and declared in a booming voice, "If our students are to attain to their proper stature in their engineering careers, we must see to it that they get a broad grounding in the humanities as well as in technology." There was generous applause.

First in the line of visitors to the dean's office, now that he is back, is the chairman of his department of electrical engineering. The chairman is looking for an assistant professor. The chairman is speaking. "Here is a man with about five years' teaching experience. He has a master's degree, and earned a degree in liberal arts before he ever studied engineering; philosophy or political economy or something of the sort. He has been chief engineer in a company which manufactures all kinds of control equipment. He has had experience in the telephone game, and he has even had a try in power utilities. He is widely travelled and has had his finger in a great many civic pies. He is highly recommended."

The dean displays no enthusiasm. He says "Humph."

The electrical engineering chairman has not succeeded in assembling too many applications, but he proceeds hopefully. "How about this fellow? He has a bril-

liant record. He's been teaching about five years too. He studied for the master's degree and then went on for his doctorate. He prepared a masterful dissertation on 'Substation Protection by Power Carrier Methods.' Since then he has been busy with research. This is a schedule of his publications. The titles all refer to substation protection. He seems to be something of an authority."

"That's more like it," remarks the dean, and a bright gleam appears in the eyes of both men.

Could not the dean and the chairman be any two of us engineering educators? We talk big about broad education, but we seem to forget all about it when we hire or promote faculty men; or when, in our early years, we are getting ourselves ready.

Or perhaps we don't forget; perhaps we have thought the matter through and have made the following assumption:

We can accomplish the broad education of our students by making them study a variegated pattern of subject matters; even when each item of subject matter is taught by a specialist in his restricted field of electronics or economics or fluid flow.

I strongly suspect that the assumption is not valid.

Broad Outlook Necessary

Although I am by no means qualified in the philosophy of engineering education, I find myself again and again confronted by the question: can teachers turn out broadly educated young engineers if the teachers themselves are not broad in outlook, in experience and in education?

Perhaps I may be permitted to cite my own experience; after all, it is the only experience I have had. In my college days I pursued courses in political economy, history, economics, psychology and the like. I can testify that there was no abundance of broad or liberalizing value in these courses as such; nor in any combination of these courses.

The broad or liberal influence was exerted by the liberally cultivated teachers; men who had learned about the great leaders of all ages, who understood the motives and ideals which inspire the inhabitants of the world; men who had studied and worked with men and women of many different backgrounds and experiences in various territories and environments.

Possibly we have been spellbound by the glamour and fascination of the graduate schools. Graduate study and research in engineering are quite the fashion. If any one of us is not exercised about them, he loses a vast amount of face. This is as it should be. The graduate schools and research centers are the inspiration and the fountain head of much of engineering progress. And so it is, I suppose, that we hire specialists who can teach the graduate courses; and we fondly hope that broad undergraduate education will come out of it all, somehow, as a by-product.

But is not the tail, perhaps, beginning to wag the dog? Last year there were 18,522 graduate students of engineering in the United States; however, there were 142,954 undergraduates.

Should we not beat up our courage before long and squarely face the issue? Have not the objectives and the methods of graduate and of undergraduate instruction become so divergent that one man can hardly be expected to do a good job in both?

In the graduate school, we train the specialist * in technology; in heat measurement, in viscosity or in vibration. The narrower and more restricted the field of work, the more expert, presumably, the student will become. And the narrower and more restricted the field of the teacher, the more effective, presumably, will be his teaching.

Undergraduate Teachers Should Be Versatile

In the undergraduate college of engineering, on the other hand, we strive,

* This appears to be prevailing practice in spite of occasional insistence in some quarters upon broader graduate programs

principally, to develop a man who proposes to become an engineer. We want him to have a grasp of the basic or elementary principles of engineering, and to know how to apply these principles to any ordinary situation to which they are pertinent. And we want him to grow into a citizen of broad understanding, information and interest. Hence, the ideal undergraduate teacher should doubtless be versatile in his engineering competence and experience, and a cultivated man of the world.

It may well be that we shall never fully succeed in fitting together graduate and undergraduate instruction. But why not try? In October, President Killian addressed the annual meeting of the Engineers' Council for Professional Development. He told them that the teacher of humanistic subjects must have status and privileges in the schools of technology equal to the status and privileges of the teacher of science and engineering. Should we not paraphrase his injunction and insist that the versatile and broadly cultivated engineering teacher shall have status and privileges equal to the status and the privileges of the technological specialist?

If we could accomplish that much, the solution of our problem might at least be in sight.

College Notes

A grant of $400,000 to the **Massachusetts Institute of Technology** from the Edwin Sibley Webster Foundation to establish an Edwin Sibley Webster Professorship of Electrical Engineering was announced by Dr. Karl T. Compton, Chairman of the Corporation of the Institute.

A special program in the colloid chemistry of Elastic High Polymers in Science and Industry will be held at the **Massachusetts Institute of Technology** from June 16 to July 5.

The course is planned to present to those actively engaged in the production and industrial applications of natural and synthetic elastomers the latest information on the chemical composition, structure, and production of elastic high molecular colloids of organic and inorganic composition.

The appointment of Malcolm S. McIlroy as assistant dean of the College of Engineering at **Cornell University** effective July 1, was announced by President Deane W. Malott. McIlroy was graduated from the electrical engineering course at Cornell in 1923 and received the doctor of science degree at M.I.T. in 1947. Before joining the Cornell staff in 1947, he was with the General Electric Company, Schenectady, and the Central Hudson Gas and Electric Corp., Poughkeepsie. He also taught at M.I.T. and during the war was assistant director of the M.I.T. Radar School.

Development of an educational program designed to spread information on the facts and future of atomic energy was announced by **Michigan State College.**

College officials said the first phase of the program would be a two-day conference titled "Atomic Energy and the Future" scheduled May 20–21.

"The Infinite Sphere"*

By ALBERT E. SANDERSON

Associate Professor of Drawing, Northeastern University

In order for a student to become proficient in the use of Multi-View Drawings it is necessary that he understand thoroughly the relationships between the various views. I have long been in search of a better way to illustrate these relationships.

The classical method for obtaining the necessary views is through the medium of the "Glass Box." In this method the object to be drawn is placed at the center of the box. Projectors are then drawn from the object, intersecting the transparent sides. These points of intersection are connected to form the views and the sides of the box are then developed.

It must be conceded that this method, though thoroughly artificial, is a convenient and satisfactory method of obtaining the principal views.

Though considerable mental concentration is required, the student is generally able to visualize similar steps leading to the solution of primary auxiliary view problems.

It will, however, be generally admitted, I think, that in the matter of illustrating oblique (i.e., secondary auxiliary) views the "Glass Box" Method leaves much to be desired. The task of visualizing the unfolding of two auxiliary planes is a difficult one even for a drawing instructor and an almost impossible one for an inexperienced student.

Direct Method

Of recent years the Direct Method of teaching Multi-View Drawing has achieved some popularity. This is the method in which the observer looks directly at the object and draws that which he sees, using any preferred position of the eye. This method does away with the planes of projection entirely, employing only reference planes from which to take measurements when working between views. This is the method in use at Northeastern and it has been found particularly satisfactory in correlating Descriptive Geometry with some parts of the Engineering Drawing Course.

In using the Direct Method, as mentioned previously, the eye of the observer is free to move to any desired location. In order for the rays to approach parallelism the distance from the object is generally assumed to be infinite. As one visualizes this roving movement of the eye the surface generated is seen to be that of a sphere.

I have designated this spherical surface as the "Infinite Sphere." In the pages which follow I have drawn the sphere and plotted views upon its surface. It is, at least from a theoretical standpoint, possible to illustrate in this manner any multi-view problem in Engineering Drawing or Descriptive Geometry and to have the entire solution visible in pictorial form. We are thus relieved of the necessity for traveling around corners to get from one view to another and all views assume their proper spatial relationship. What is most advantageous is the fact that the student

* This paper presented at the Drawing Conference of the Fall Meeting of the New England Section of ASEE at the University of Rhode Island on October 13, 1951.

is able to look at a pictorial of this type and to connect it without difficulty with his drawing.

With the eye at infinite distance the radius of the sphere also becomes infinite, so that, within the limited area of each view, the surface may be considered a flat plane.

Illustrations for Classroom Instruction

The drawings which follow are samples of the type of illustration which may be used in classroom instruction.

Fig. 1(a) shows the three principal views of a cut block. There is no definite orientation to the pictorial. Each of the views may be made to serve as top, front, or right and left side views by rotating the page. The ninety degree relationship between views is thus clearly established. This picture also shows, for example, why it is possible to draw a side view either in its normal position adjacent to the front view or in the "second position" adjacent to the top view. Fig. 1(b) is a multi-view drawing of the same object.

Fig. 2(a) shows the principal views together with a primary auxiliary view. A reference plane has also been drawn in. Note that this plane touches the right hand side of three of the views and in each of these the plane is seen on edge in Fig. 2(b). This illustration is useful in demonstrating that the width of the auxiliary view may be obtained from any view in which the reference plane is seen on edge. As in the previous illustrations there is no definite orientation to the pictorial. By rotating the figure the three common types of auxiliary views may be illustrated and in each position the reference plane will be seen in its proper place.

Fig. 3(a) shows that it is possible, on the surface of a sphere, to show the principal views, a primary auxiliary view and an oblique view, together with the necessary reference planes and have the picture easily readable. It also seems much simpler to connect a pictorial of this type with the working drawing than by previous methods. This illustration may also be rotated to show how the edge views are obtained when horizontal, frontal or profile principal lines are used as the direction of sight.

It is believed that this type of illustration will be found most useful when made up into permanent drawings for display

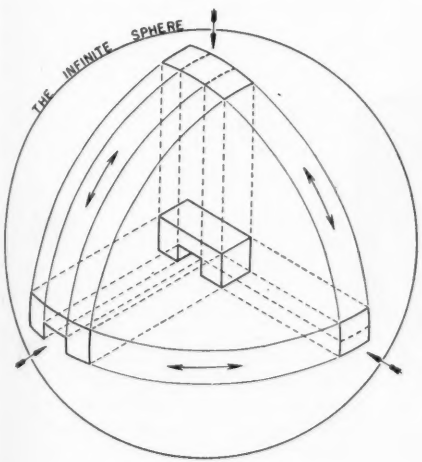

FIG. 1(a)

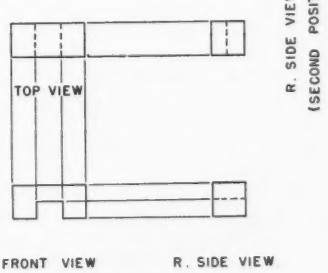

FIG. 1(b)

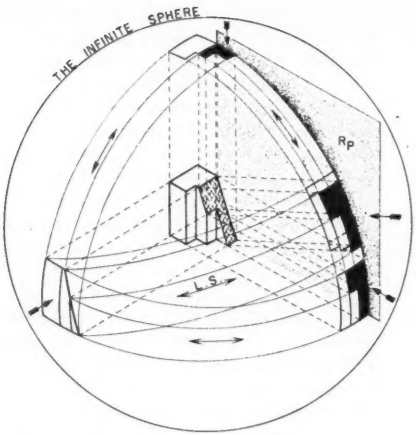

FIG. 2 (a)

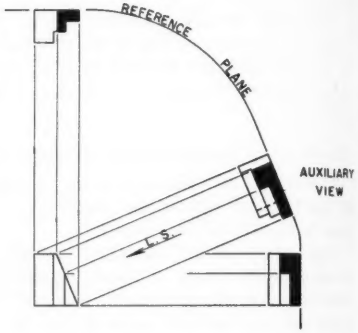

FIG. 2 (b)

purposes. It is not easy for an instructor to sketch on the blackboard a problem on the surface of a sphere unless he has made a preliminary trial, since the proper relationships between views are not easily obtained.

This idea was suggested by the Celestial Sphere which is used in Astronomy—particularly that phase of Astronomy used in Higher Surveying. It may be shown that certain problems in Descriptive Geometry have a close relationship with

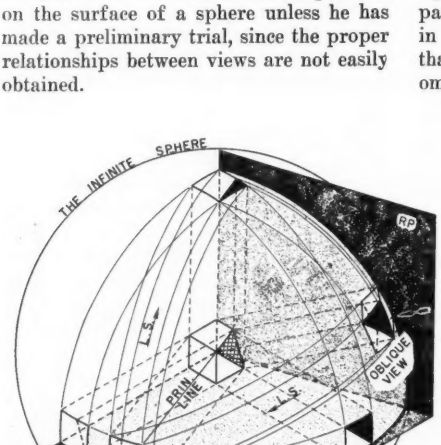

FIG. 3 (a)

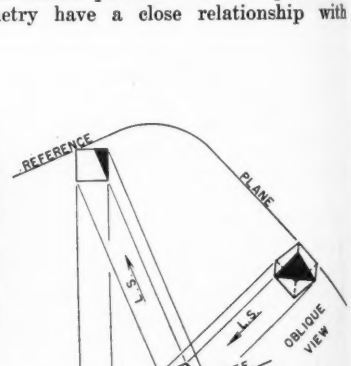

FIG. 3 (b)

similar problems in Spherical Trigonometry when represented on the surface of a sphere. This is an angle which would seem to be worth further investigation.

Conclusion

In conclusion, let me say that what I have presented here represents no cure-all for lack of aptitude, but it does, in my opinion, present the basic principles of Multi-View Drawing in better fashion than by previous methods. I have been very much surprised to find that the "Infinite Sphere" has been as much help to the teacher as to the student.

As a further extension of this idea it seems likely that solid or transparent plastic spheres might be used to advantage with the problems worked out on the surface. A sample sphere may be seen on the platform.

It is to be hoped that drawing instructors in other institutions will give this method a trial and that we may have a worthwhile discussion of its merits at some future date.

College Notes

L. E. Grinter, Vice President of the ASEE and formerly Vice President of **Illinois Institute of Technology**, has announced his appointment as Dean of the Graduate School and Director of Research at the **University of Florida.** At Gainesville, Dean Grinter will assume responsibility for a graduate student body of 1500 students and a research program involving an expenditure of several million dollars annually. He expects to take up his new duties at the beginning of the fall semester. For the past two years Dr. Grinter has been consultant to the Board of Control for Southern Regional Education and is now a member of the Board's Commission on Graduate Studies. Dr. Grinter came to Armour Institute of Technology in 1937 to organize the graduate school and to serve as its first dean. With the merger of Armour and Lewis Institutes he became the first vice president of Illinois Tech and was responsible from 1940 to 1946 for the Institute's coordinated educational and research program. During this period Illinois Institute of Technology developed its College of Liberal Arts, its Extension Division for educational cooperation with industry, its scientific research options, its management options, and its industrial safety program. Several major departments were also established including metallurgical engineering, naval science, biology, food engineering and psychology including the Institute for Psychological Services. The distinction of the faculty assembled under the leadership of Dean Grinter has attracted national attention.

Since 1946, Dr. Grinter has been research professor of civil engineering and mechanics at Illinois Tech. He has also served as chairman of the Panel on Equipment and Construction for the Department of Defense in Washington and in this work he has had the assignment of developing cooperation between the Army, Navy and Air Force in the field of research. Since 1948 he has been a consultant to the Research and Development Board on the resistance of structures to Atomic explosions.

The writings of Professor Grinter include numerous scientific monographs and a half dozen books in the fields of structural engineering and mechanics. He also writes articles on graduate and undergraduate education. Under Dr. Grinter's direction two major ASEE committee reports are now approaching completion—one is a study of graduate education and the other a report on improvement in the teaching of undergraduate students. In this Society he was responsible for the organization of the Graduate Division and served as its first chairman.

The Place of Cooperative Education in Modern Industry*

By C. R. OSBORN

Vice-President, General Motors Corp.

The subject of my remarks today is "The Place of Cooperative Education in Modern Industry." Because of the uneasiness which is evident on every side, among our students and, in fact, every strata of our people, brought about by world conditions and our internal situation, perhaps I should talk about cooperative engineering and its place in our modern world. Such an all-encompassing subject provides a wealth of material to consume hours of your time and not too profitably either, because I must admit that I am as confused as many of you on the proper answers to these complexing problems. However, they will have to be dealt with and undoubtedly will be dealt with by some of the graduates of our cooperative schools, who by reason of their character, their method of education and their habit of dealing honestly and directly with facts, are peculiarly well equipped to assume these responsibilities industrially, politically and otherwise.

Living in a World of Change

I am sure of one thing which permits of no argument, that we are living in a world of phenominal change and the sooner an individual is brought face to face with realities, with facts as they are, the more we can expect of him and his valuable contribution to himself and to the world community. Speaking from a technological point of view, no set of text-books can possibly be kept abreast of the rapid phenominal changes as they have occurred over the past few years. To give you a few examples; several weeks ago I visited our Allison Division where, among other products, we make turbo-jet engines. I was shown a new engine which had just completed it first few hours of operational tests and had proved to be one of the highest thrust engines ever to have been designed and produced in the world. It had not then started what we term its "type test." Later in the day, our engineers showed me some new designs which when completed would, beyond any question of doubt, obsolete the engine that I had just seen. In fact, it is a common saying among our Allison people, working in this jet engine field, that by the time you have an engine through the Model Shop and can see it in the flesh, it is already obsolete. How can such rapid change in progress be adequately covered in our text-books.

Today in our diesel locomotives, we regularly obtain 750,000 to 1,000,000 miles on our pistons and cylinder walls before re-boring is necessary. A few years ago we were quite happy when we realized 100,000 miles before replacement.

One of Mr. Kettering's favorite stories relates to an experience he had several years ago. He happened to accompany one of our noted educators through a display set-up in a Detroit hotel in connection with an SAE Convention. We had one of our new diesel engine pistons in this dis-

* Presented at a special Centennial event entitled, "A Day on Co-operative Education" at The Technological Institute, Northwestern University, November 8, 1951.

play. The educator stopped and examined the piston very closely and finally asked Mr. Kettering if it had ever been used in any application. Ket replied in an off-hand manner, "Oh yes, it is used in all of our diesel engine applications to railroad motive power." The educator then inquired as to how much success we had with this piston; and when Ket replied it was tremendously successful, his friend stated that it just couldn't be so. He pointed out numerous design features that were in conflict with every known principle of good piston design and finally said, "Ket, if that piston works, we will have to throw away every text-book in the country" Ket said, "Well, John, the engine that uses this piston hasn't read the text-books." He said, "All we did was to act as an errand boy. We made up one set of pistons, put them in the engine, ran them a while and asked the engine how it liked them. We took them out and looked at them and the answer was quite evident—the engine didn't like them. We made another set and the engine liked them a little better. Acting as errand boy we trotted back and forth with new sets of pistons until finally the engine said, 'I like this piston design just fine,' and that, my friend, is the piston you see there." Ket then said, "John, by the way, have you ever been a piston in a diesel engine?" And that ended the argument.

In our gasoline engine designs, chemical improvement in fuels, or, in other words, higher octane gasolines obtained through advanced cracking processes and additives such as ethyl, have until recently provided the entire foundation for our development work in obtaining increased horsepower and improved economy in engine performance.

Now we are accomplishing the same result through unusual designs of compression chambers and piston crowns, the results of which we can and do measure in what we call mechanical octanes. Mechanical octanes are just as effective as chemical octanes and save the vast sums of money required to obtain high chemical octanes in fuel. We are now looking forward to engines with compression ratios of 10 to 12, without having to pay the excessive investment penalty of very high chemical octane fuels; and which in turn will so improve the economy of our engines that they represent the equivalent of vast discoveries of new oil basins. Again, so much progress is being made in this field that the text-books cannot currently be kept up-to-date.

In the chemical field, materials are being created which displace cotton, silk and wool at a lower price, and with better functional values.

In the atomic field, no one knows—good or bad—what is in store for us. We do know, however, that if the use of atomic energy can be confined to peaceful ends, unbelievable results will be accomplished in new applications of this powerful source of energy.

A Great Change in Industrial Relations

There is also a great change which has occurred in the last decade in our human or industrial relations, as we call them. All of our young men starting a career in any type of industrial enterprize would do well and, in fact, must keep abreast of the thinking and attitude of our working people. They must recognize that their ideas, aims, and ambitions will have to be dealt with fairly and intelligently and politically with the world condition such as it is today.

It is to be hoped that our Universities through their curricula will provide the proper emphasis on the world's political problems to insure at least an understanding of the significance of world events as they occur; and with this understanding, that this host of young men, turned out by our Universities everywhere, will assume their rightful and proper responsibility in the selection of their leaders to deal intelligently with these all-important world and internal political problems.

Summarizing, it does seem to me, with the rapid change in every field of human activity which is so prevalent today, that we have an important problem to deal with, in our educational system which can-

not be adequately handled by the normal college curricula. I do believe, however, that our cooperative system of education provides an important and unique opportunity for the young man starting a career today, an opportunity to keep abreast of these developments in the specialized field he may select and an opportunity that is not so readily available to him in any other way.

I don't want to leave the impression that I discredit the books or educational methods now in use in our Universities, cooperative or otherwise. After all, the jet engine as we now know it didn't appear in full bloom as a finished product on our design tables and Model Shops overnight. Our engineers obviously had to have a thorough grounding and understanding of basic thermo-dynamics which they acquired in some University, before they could even understand what goes on in a jet engine. And, even so, it is generally recognized, we still know very little of all the things happening in a jet engine when it is turning out such tremendous horsepower. I should like to mention in passing, however, that the youngster studying thermo-dynamics in a University has a tremendous advantage, if, in his shop work he is exposed to jet engine design and performance, concurrently with his University studies. I did not have this opportunity when I was in school, and thermo-dynamics as a result was a pain-in-the-neck to me instead of the very vital and tremendously interesting study it could have been.

My experience with hydraulics was the same. When we started this course, our professor stated that we could not expect to memorize all of the hydraulic formulae that we would encounter in the book; but he did state that he wanted us to understand the formulae and its application, to the extent that when we had a problem to be solved, we could go to the book, select the proper formula and apply it correctly. Therefore, whenever we had an examination, we were permitted to use any books or notes that we had available. The President of Purdue University told me of an experience that they had had in one of their hydraulics examinations. In their school they also permit their students to use any text-books or notes they have available in answering their examination questions; in fact, their hydraulics professor told his class that they could use anything in the examination that any student could carry into the room on his back. The next day, one of the students came into the room carrying the previous year's hydraulic genius on his back.

But to return to my point, I think the cooperative school should give to their students just as thorough education and understanding, as a full-time school, on all of the basic subjects, such as physics, mathematics, chemistry, electricity, strength of materials, machine design, and all of those basic sciences and laws on which all research and design progress, must be based. In this respect I have no complaints or suggestions to offer, because with the faculties we have in our schools and with our advanced text-books, I think that our students' education is in good hands.

Nor do I want to leave the impression that I discount the tremendous value of our straight-time schools and the product they turn out, such as MIT and all the other fine educational institutions which, in fact, constitute the great proportion of our technical schools. We must not discount the fact that any engineering graduate, to be worth his salt, must understand the basic sciences, must of necessity, by reason of his engineering education, learn to think straight and to think honestly. And it does appear to me that schools operating on a full-time basis have a better opportunity within their student and post-graduate body, to better carry on basic research activities, for which there is a very great need in this country by reason of our political and economic position of world leadership.

The cooperative school need not shy away from basic research; nor do they indeed. But it seems to me that they tend more toward that equally important field of applied science.

Now, since I have indicated that I feel an excellent job is being done in the purely educational field in our cooperative universities and have stressed so much the inadequacy of text-books to keep pace with the rapidly changing field of great engineering complexity and advance, you might reasonably ask what do I propose doing about it. I have two suggestions to make; one of which has to do largely with industry's responsibility in this educational job and the second with a proposal to the universities for their consideration.

Suggestions for Cooperating Industries

While a Co-op student at the University of Cincinnati, I spent the first year and a half in a Heat-treating Department, because the Foreman liked my work and the school coordinator couldn't do anything about it, nor could I. I learned all there was to know in this department in six weeks and should have been moved on. Perhaps this type of situation has improved importantly over the years, and I am sure, it has; but I am equally sure that, as Plant Manager, I could have seen to it that a much better job was being done in intelligent rotation of jobs for our co-op students, so that they would have been provided with a thorough and well-rounded education with up-to-date knowledge of engineering and manufacturing practices that cannot be obtained in text-books, and which actually was the objective that Dean Schneider had in mind when he created the Cooperative Plan of Engineering Education. I have the following suggestions to make, and I make them with the knowledge that some of them have been part and parcel of the cooperative method of education for more than fifty years; but I repeat them because I know that they must be emphasized and re-emphasized in your contacts with industry if we are to realize maximum advantage from the cooperative scheme of education. They are as follows:

1) Co-relate shop work with the University curricula to the maximum degree, subject by subject and year by year.

2) Insure that the student spends a goodly portion of his time as a workman so that he becomes familiar with their thinking, their attitude, and their ambitions. He should likewise be required to become thoroughly familiar with the Labor Contract, its concept and operation.

3) During his first two years, he should cover production routings, tool design, machinery application, engineering, drafting and design, in fact, all the basic functions of a normal engineering and manufacturing activity. His training in the factory should be just as intense, well planned and well ordered as it is in the school. A youngster educated in such surroundings, if he is an engineer at heart, will eat it up. If he isn't, the sooner he finds it out and shifts over to another activity, the better off he will be. It is my observation that in Co-op schools we have the outstanding advantage of correcting the errors of the parents, who, because Dad is an engineer, young Johnny must follow in his footsteps. And except for the Co-op schools Johnny, who is a fine lad and wants to please his parents, because of the money they are spending on him, doesn't find out that he is not an engineer, and doesn't like engineering, until after their money is spent, the four years used up and he gets out in the shop and starts to get his hands dirty. It has been my observation that most of our lads in Co-operative schools want to be engineers. All I am saying is, let's take maximum advantage of that fact and not discourage the embyro-engineer by putting him in the blue print room and keeping him there, because he is very adept in learning how to fold up a blue print in the complicated fashion we use. Let us be sure that they do get—the KNOW HOW—the one thing that pays off—for them and for us.

4) During his last two years, he should divide his time between production processing, which will provide him with a thorough background in modern machine tool design and application and an appreciation of the progress currently being made in technological advancement,

5) and advanced engineering design. He should be associated, to the maximum degree possible, with the group or groups of engineers and designers who are responsible for the conception, design and test of the most advanced engineering and research projects. These last two years are particularly important in the training of our young men, so that we can effectively bridge over the gap between our basic theoretical training in the schools and the tremendous advancement occurring each year in the technical sciences.

6) Finally, and to repeat, see that the cooperative plan of education is administered in accordance with its original concept, without any intention of paternalistic attitude or favoritism. Industry must watch and control the activities and progress of the student in the factory and laboratory just as closely as their time, activity and results are controlled by the faculty in the school. Anything short of this requirement defeats the purpose and value of this very important and advanced type of education.

Suggestions for Cooperative Plan Colleges

My second major point, as I have mentioned, has to do with a suggestion to the school. I am very much in favor of education, where opportunity permits, by case example. Case example in my vocabulary is another way of saying, "Education by recount of experience." Let me explain my idea of how this can be effectively introduced in our educational scheme of things, if it is not already in existence in our schools.

I would set up a *case example* one-hour lecture course per week for the entire senior year. Northwestern University has Co-ops, as we call them in Cincinnati, working at a number of different plants throughout this area. One of these plants has developed a new type of piston, which I have already mentioned. Another, a new advanced type of compressor for a jet engine. Perhaps another has a new method of making soap. Another, a new material to replace all of the insulating materials, with many times the life and effectiveness of the old materials. Another, a new manufacturing method, which has reduced productive hours by 50%. Another, an executive who has just returned from an important Washington or European post, who has an unusual fund of knowledge on our foreign and domestic problems and policies. I know that these industries with whom you are in regular contact have a fund of knowledge touching every aspect of advanced manufacturing practices, modern design, experiences in industrial and human relationship, which, if made available to our students in the form of papers or lectures by responsible people within industry, could become the nucleus and foundation of a new course of tremendous interest and value to our engineering students. This activity, too, would provide a long step forward in bridging over the gap between our basic educational activities and the progress currently being realized in our modern industrial engineering and research activities. Perhaps you have such an activity here and in other schools throughout the country; if so, I am sure you would confirm my conviction that such a program can be made of vital importance in our educational problem in this age of rapid change and development.

A few years ago, the maximum power used in an airplane engine was about 450 hp. Today, when we discuss our products and future plans, plans which must become an actuality within a few years, horsepower figures per individual plane are nonchalantly discussed at 35,000 to 50,000 hp. Most of the men doing this work are in their early 30's. Following our discussions of the product, we usually go out to see one of these new engines in operation. The buildings over your head and the ground under your feet shakes and your stomach feels like it is taking off. You look around at the young engineer who unleashed all of this tremendous horsepower to see if he is impressed as you are. He is totally unconcerned; and the thought always goes through my head,

"Father, forgive them; for they know not what they do."

A few days ago a group of us visited the new Du Pont Research Laboratories. One after another, young men, most of them in their late 20's or early 30's, described their individual projects and activities. It was an amazing experience to see the things which were being done and to hear of their confident expectations for the future.

Conclusion

I might sum up my remarks by emphasizing that in these days of phenominal change, we cannot expect the universities through their faculties and text-books to assume the entire responsibility for fully equipping our youngsters for the job which lies ahead. Industry, too, has a responsibility and a very important stake in this educational job.

In our position of world leadership, it is difficult for us to know how well we are faring in the area of political activity, but I believe we can all agree that with this combination of our world leadership and the political maneuvering which exists, no time can be lost in assuring the most effective results from the graduates of our technical schools, in the shortest possible time. Industry and our technical schools have a joint responsibility and if they will each cooperatively do their part, supported by the intellectual freedom, that exists in this country, we should have no fears for the future.

Sanitary Engineering Conference

A two-day conference on Sanitary Engineering Education sponsored by Committee 3 of the ASEE Civil Engineering Division, with the cooperation of the U. S. Public Health Service and the American Public Health Association, will be held at Dartmouth starting Saturday, June 21. The program of the conference is as follows:

Saturday, June 21

1:00 p.m.	Radiological Training
1:45	Field Training
3:15	Training Sanitary Engineers (panel discussion)

Sunday, June 22

9:30 a.m.	What is the Present Day Field of Sanitary Engineering?
10:30	Minimum Requirements for Sanitary Engineers
1:30 p.m.	Sanitary Engineering in the Smaller College
2:30	Graduate Program
4:00	Adjournment

Monday, June 23 Committee Reports

Arrangements for the conference are in charge of the following special committee:

Gilbert Dunstan, Chairman
Jess C. Dietz, Co-chairman
Arthur P. Miller
Ellis S. Tisdale
Earnest Boyce
E. S. Brown
William T. Ingram
E. J. Kilcawley

This committee is working in cooperation with Committee 3. Reservations for the conference should be made with Professor E. S. Brown of the Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire.

A Joint Attack on the Mathematics Entrance-Requirements Problem

By L. A. ROSE

Director of Engineering Information and Publications, University of Illinois

What is the biggest problem that plagues curriculum-makers? Manifestly the answer varies from one engineering college to another. But it's a safe bet that high on the list of "headaches" would be these three: What shall be the first required college course in mathematics? How much mathematical training can we expect of high school graduates? What guidance and help can we give to high schools so that we may receive students who have the preparation they need?

These are old problems everywhere, and everywhere they have become more pressing in the past few years. What we are doing at Illinois in an attempt to solve them will, we trust, prove interesting and indeed applicable beyond the borders of our own state.

Our Approach to the Problem

Three years ago we opened a broad attack on the problem. We began with the all-too-obvious fact that the engineering curriculum is badly crowded. In four years we can scarcely give students the fundamentals which they must have. Moreover, we must provide enough courses in the humanistic and social fields to encourage our students to become well-rounded individuals and effective citizens. Our problem, we felt, is to assure the fullest possible use of the time available for engineering courses without making our curricula narrow.

Now this brought us straight to the problem of mathematics requirements. In a sequential program such as engineering, a good deal of mathematics is needed as a prerequisite for physics, which in turn is the basis for most of the engineering courses. These truisms led us to experiment with requiring that the student take physics and certain engineering courses concurrently. The arrangement did not work. The only conclusion we could come to was that students expecting to graduate in four years should be ready for analytic geometry upon their admission to the College of Engineering.

The Solutions We Are Attempting

The conventional way to secure this aim is to require that students should present, for admission to the College, 2 units of high school algebra, 1 unit of plane geometry, ½ unit of solid geometry, and ½ unit of trigonometry. And we adopted this as one method, to go into effect in September 1953.

But we were unwilling to stop with such a solution. It was too rigid. It stressed means—academic machinery—rather than ends—skills and competencies. It would bear hard on students in smaller high schools. It would bear hard likewise on students in large high schools who may not choose an engineering career soon enough to take more than three years of high school mathematics.

The single-track solution would also be unfair to such high schools as are or will be experimenting with nonconventional division of the subject-matter of mathematics or with new teaching methods.

We did not want to hamstring those pioneers.

Consequently we carried our thinking further. In doing so we were guided by the Steelman report and other fairly recent national studies. We were also guided by a Bulletin of the Illinois State Department of Public Instruction, "New College Admission Requirements Recommended: A Proposal for Cooperative Action by the Secondary Schools and Colleges in Illinois" (No. 9, Circular Series A). We were encouraged and stimulated by the following passage in that publication:

> For specialized curricula, which begin in the freshman year in a college like engineering, certain specified competencies on the part of high school graduates may be required, such as competence in mathematics for engineering. For such cases the adoption of the following is recommended: "Secondary schools are urged to provide means for high school students to acquire prior to graduation the competencies demanded for successful work in specialized programs in institutions of higher learning, such competencies to be determined on the basis of standardized tests rather than on the basis of passing specified courses."

It's time to identify more fully this "we" I've been speaking of. "We" were not only the College of Engineering but also the College of Education and the Department of Mathematics. The three agencies worked through a joint committee which gathered data and views from many sources. These included not only the pertinent literature but a number of cooperating high school teachers whose aid was most valuable.

One of the biggest things the joint committee did was in part to anticipate and in part to follow up the recommendations in the Bulletin of the State Department of Public Instruction. Specifically, the committee prepared a list of the minimum mathematical needs of prospective students in the College of Engineering. This list comprises 97 topics in secondary mathematics, an understanding of which will enable the student to begin his college mathematics training with analytic geometry. The topics run from fundamental operations with integers, common fractions, decimals, and mixed numbers through trigonometric functions of an acute angle to addition and subtraction of vectors by components.

Thirty of the topics, which were identified by asterisks, are those normally studied in advanced (college) algebra and trigonometry. Students who have an understanding of all topics except those thirty will begin with college algebra and trigonometry as their first mathematics courses at the University These students will probably require an additional semester—that is, a total of four and a half years—to complete any one of our engineering curricula.

The committee drew up an additional list of thirteen topics recommended for study when time is available or by secondary school pupils of high ability. This list includes probability; the inverse, converse, and contra-positive of a statement; line values of trigonometric functions; and De Moivre's theorem.

The lists comprise about one-fifth of the material in a brief bulletin issued in October 1951. Its title is "Mathematical Needs of Prospective Students at the College of Engineering of the University of Illinois." More than 7000 copies of this publication have gone out to American high schools, and additional copies to engineering educators throughout the United States. Dean William L. Everitt and other administrators have orally set forth the gist of *Mathematical Needs* before groups of high school teachers.

To make the point still clearer, *"Mathematical Needs"* and our speakers offer rather detailed suggestions on counseling to high school classroom teachers and to high school advisors, many of whom know relatively little about the whats and whys of engineering-college entrance requirements and courses.

Ways of Meeting Our New Requirements

On recommendation of the joint committee, we went further yet. We specified

three ways other than by offering four units of high school mathematics in which students may fulfil the entrance requirements that will go into effect next year. These three ways (four ways, some people prefer to call them) are as follows:

1. By passing (a) a general proficiency examination in mathematics that covers the "indispensable skills"—the 97 topics —listed in *Mathematical Needs* or (b) proficiency examinations in the individual subjects which after September 1, 1953, will constitute the mathematics entrance requirements.

2. By passing correspondence courses. The University of Illinois Extension Division is offering, to students who have had 1 unit of algebra and 1 unit of plane geometry, the other mathematics courses needed for admission to the College of Engineering. Naturally, successful completion of correspondence courses offered by other accredited colleges and universities is equally acceptable.

3. By passing, at the University of Illinois, mathematics courses in which they are deficient. These may be taken in the summer session prior to the first full freshman semester. Some students may have to take an extra semester rather than merely the summer session; only a small percentage, we anticipate, will require an extra year.

We believe that—assuming proper guidance, aptitude, and ambition—the new admission requirements do not present undue difficulties for any high school student who wishes to be admitted to the College of Engineering of the University of Illinois. Although the new requirements call on some high schools to include more material in their mathematics courses, we believe that they permit and indeed encourage latitude in planning the high school mathematics program. High school teachers and officials have commended our cooperative approach to the problem, our concern for their difficulties as well as our own, and the variety of ways in which our new mathematics requirements can be met.

What Remains to be Done

But beliefs must be supported and praise lived up to. So we are developing the use of *Mathematical Needs* by cooperating in two additional joint committees with the College of Education and the Department of Mathematics. One committee is advisory to the experimental program in our University High School, incorporating these studies into an operating high school program. The other committee is studying the proficiency examinations which will be given to freshmen on entrance. We shall probably be issuing bulletins on the results of these studies.

In addition, we have been asking our fellow engineering educators to comment on our analysis of the problem, our approach to it, and our proposed solutions. This article itself is in part, then, an invitation to all interested readers of the Journal. We want your criticisms of what we have been trying to do. Copies of *Mathematical Needs* are still available, though in no large numbers. If you would like to read it and give us your reactions, we shall be glad to have them. The greater the exchange of information and views about this important curricular problem, the greater is the likelihood that we shall arrive at solutions which will best help the student to adjust to our own various situations and those of the secondary schools.

Report of The Student-Faculty Evaluation Committee

Introduction

The first report of the Student-Faculty Evaluation Committee was presented at the Annual Meeting of the ASEE, Seattle, Washington, June 22, 1950. It subsequently was published in the October 1950 issue of the *Journal of Engineering Education.*

Included in that report were a summary of the work of student-faculty evaluation programs up to that time and a discussion of the duties and responsibilities of students and teachers. The opinion was expressed that evaluation of faculty by students will probably continue in many schools. Further study of methods was recommended, with formulation of a suggested program for such evaluations.

The Need for Evaluation

It was stated in the 1950 report that the Student-Faculty Evaluation programs are not directed against any specific group of teachers. Rather, they are against the supposed general, unrecognized faults of most teachers. They indicate discontent on the part of many members of the student body; they indicate doubt as to whether the time, energy and money of the student is yielding him the return that he has the right to expect. The widespread development of evaluation programs in schools all over the nation probably constitutes a serious indictment of our collegiate education. Such an indictment cannot be shrugged off; it calls for careful study of the underlying causes of the discontent of which the programs are one manifestation.

Careful study of answers obtained in the evaulation programs shows that the principal offenses and shortcomings of which the teachers are accused are:

Lack of knowledge of subject;
Lack of fairness in grading;
Lack of interest in the student;
Etc.

Which of these are the fundamental causes of discontent and which are only symptoms? Your committee believes that, while individual teachers fail in fairness, in knowledge of their subject, in logical presentation, or in interest in the subject, the fundamental failures are not in these matters, but in the field of human relations.

Student-Teacher Relationships

The relation between the student and the teacher in the classroom is not a simple one. The student has no clear over-all picture of what each course should be; he has to take it for granted that the work assigned for each day is necessary. Still the student is basically the employer of the teacher. Unlike most employers, however, he lacks effective means of expressing his dissatisfaction with the service he is rendered.

The ideal classroom situation is one of give-and-take, wherein the student is free to question any statement and to express his opinions with complete confidence that his grade will not suffer because of such expression. Under this condition the students, being altogether human and somewhat immature, will frequently place themselves in untenable positions, as all of us now and then do, but that is an inevitable part of the seasoning that makes the person mature. Each slip of this kind is an opportunity for the teacher

to help his students to orient themselves personally and professionally. To waste these opportunities—to criticise the student who thinks erroneously, instead of helping him to correct himself—is to discourage and antagonize those who most merit help.

The autocrat of the classroom is a frequent object of complaint. Even if his teaching is technically excellent he still falls far short of his goal, for his autocratic attitude, his failure to permit students to function as thinking individuals, thwarts their development, no matter how sound may be the material that he presents. If he is autocratic because of the fear that the student may show up his incompetence, the student's situation is indeed sad. He has a valid cause for complaint, but dares not speak up because he feels that to do so will likely lower his grade.

The student-teacher relationship may be compared with that of the baseball player and his manager, or the automobile driver and the traffic cop. Human nature being what it is, there will inevitably be some teachers who, from their "superior" position, fail to accord to their "inferiors" the respect due a fellow human. The "superior" attitude will inevitably antagonize the students, setting up a block to the completely free play of ideas which is so essential to good teaching.

If practically all teachers were genuinely interested in the welfare of the students—if the teachers felt that the students were not entirely to blame if they learned little—if the teachers accorded the students due respect at all times and especially when they correct them, the Student-Faculty evaluations would never have started, regardless of how ineffective the teaching techniques were. The poor student seldom knows when the teaching is ineffective although he may think he does. The good student may recognize ineffective teaching, but he has enough self reliance that he does not mind. Virtually all students recognize and appreciate those teachers who are interested in their welfare; and they will forgive most teaching errors if the human interest is strong.

Proposed Evaluation Procedure

Your committee believes that some of the student-faculty evaluation programs that have been used in recent years are negative in both intent and effect, and that such programs will not continue long. We believe, however, that the student should have some means of expressing his views regarding the teacher and the course. He believe that the best way to accomplish this is as follows:

During the week prior to final examinations the student be handed a sheet of paper and an envelope. At the top of the sheet should be printed something like the following:

To the student:

Your teacher would appreciate having any comments you may wish to make regarding this course and his method of teaching. He particularly would like to know what you think could have been done that would have helped you to learn more.

After you have written your comments, place this sheet in the attached envelope and seal it. Write the teacher's name and the course number on the envelope and drop the envelope in the box provided in the department office. Your teacher will not pick up the envelopes until after the final grades are turned in to the registrar. These sheets will not be seen by the department head, but will be a great help to your teacher. Check one:

(a)—This course is an elective

(b)—This course is required in my program

Your committee believes that comment regarding teaching is strictly a matter between the student and the teacher. If the department head or dean would like to know what the students think of the teach-

ers, another method should be used. The best method for this purpose depends upon the size of the school and the personalities involved. The department head who keeps in touch with his students and staff has no need of any artificial mechanism to tell him which teacher is doing a poor job, which one is technically proficient but is falling down in the realm of human relations, which one is outstandingly good.

Students should never be asked to vote for the one best teacher in the department. This method is wrong in more ways than there is room to list. However, it might be desirable several times during the semester, to pass out class cards for grading the teachers. On these cards the students write a letter grade, i.e. A B C D E for the teachers just as the teachers do for the students.

Conclusions

(1) Present methods, that is, methods involving check-sheet questionnaires for the evaluation of teachers by students are not suitable for a permanent "every semester" program. (2) Students should be asked for their written comments. (3) The formal student-teacher evaluation should be kept a confidential matter between the students and the individual teachers.

HARRY W. CASE
HERMAN BLICKENSDERFER
EARL H. FLATH
EDWIN H. GAYLORD
PIERRE M. HONNELL
W. B. SHEPPERD
PAUL K. HUDSON, *Chairman*
Student-Faculty Evaluation Committee
FRED H. PUMPHREY, *Chairman*
Educational Methods Division

* * * *

Electrical Engineering Summer School

The Electrical Engineering Division will hold a Summer School at Dartmouth College on June 20 and 21, 1952. The theme will be "Undergraduate Teaching of Electrical Circuits and Fields." Registration will be $1.50. For further details address Dr. J. C. Ryder, Electrical Engineering Department, University of Illinois, Urbana, Illinois.

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ANNUAL MEETING

June 23–27, 1952

Dartmouth College **Hanover, N.H.**

THE T-SQUARE PAGE

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R. T. NORTHRUP
T. T. AAKHUS
C. J. VIERCK
J. S. RISING
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DEVOTED TO THE INTERESTS OF ENGINEERING DRAWING

B. L. WELLMAN, *Editor*
Worcester Polytechnic Institute

Officers
J. GERARDI
J. G. MCGUIRE
W. E. STREET
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The Squeeze Is On

By J. GERARDI

Assistant Dean of Engineering, University of Detroit

Industrialists and professional engineers like to face facts. Engineering educators are no exception; however, a doubt may be expressed at the willingness of either group to be realistic at times. Realism seems to be evaded and too often statements of facts are taken lightly when new courses are added to a curriculum and engineering drawing courses are all but eliminated.

Talk to a group of industrialists or engineers; as soon as they learn of your association with an engineering college, invariably the discussion will follow one of two paths. If the discussion concerns the profession, our industrial friends will tend to minimize specialization and concentrate their efforts on trying to persuade the educator to broaden the curriculum, emphasizing the fundamentals of design, and urging the educators to include a well-rounded program of studies in the field of Humanities. The objective, of course, is to produce men who are not only trained in a vocational sense, but men who have an intelligent understanding of the problems related to civic, social, and community life. This point is not argued. Industrialists as well as engineering educators are demanding that much more time be devoted to the development of the whole man. The need for training in the humanities has been recognized, and today a minimum of 20% of the student's curriculum is in this field. This is as it should be.

The changes to accommodate this new requirement did not happen over night. During the period of transition, courses in the humanities were offered in place of many technical frills. Educators revised and revised their syllabi and in all probability, were amazed to learn that the student still had time to master engineering fundamentals. It is a great source of satisfaction to know that their graduate can discuss matters pertaining to philosophy, literature, political science, etc. in a rational manner. Industry also has made it known that the graduate is a more versatile individual and that the numbers of engineers in sales, management, personnel, and executive positions are increasing at a magnificent rate.

Saturation Point

However, since both the sciences and the arts are fields which constantly develop and expand, a saturation point has been reached. Technical subjects which had been cut to the bone must be expanded because of new developments which in themselves are highly fundamental; hence, directors of degree-granting departments can no longer be expected to reduce the

amount of time devoted to technical studies.

No professional engineering drawing teacher in his right mind would oppose a reasonable concentration of course content or a reasonable reduction in the time element necessary to teach drawing if as a result of his contribution, the status of the engineering graduate is improved. But it was never intended to eliminate drawing courses from the engineering curricula. Certainly no one could classify these courses as frills, nor is it conceivable that in the near future an electronic device will be produced which will record the ideas in the minds of engineers and transmit them to other people. Moreover, the Engineering Council for Professional Development has not even implied that drawing is to become a requirement for admission to an engineering school. Yet, a few well-known colleges in this country have eliminated drawing from their curricula and several schools now require their students to take only one course in technical sketching.

Employer Viewpoint

But let's talk to the men who employ engineering graduates. Here the conversation takes on a different aspect. The chief engineer or chief draftsman is proud of the fact that graduates are the finest men (in every sense of the word) he has ever employed. Their knowledge of mathematics, theory of stresses, history, economics, etc. are much more improved over that of the graduate of fifteen years ago; but they ask, "Who gave the graduate the idea that he would have several draftsmen at his call? Even if a graduate has draftsmen working for him, what respect can the draftsmen have for the graduate, or the school from which he graduated, if the young engineer does not know how to prepare a preliminary design drawing from which the draftsman can proceed with layouts and detail drawings?"

Hence, those responsible for teaching drawing courses find themselves caught between the "Devil and the deep blue sea." Pressure from educators and industrialists demanding men, who in addition to their technical training, are prepared to assume leadership in the field of human relations as well as the responsibilities which are imposed on professional people in a complex society. Pressure from the immediate supervisor of the neophyte who is more interested in meeting production schedules than in the "development of the whole man."

But let's be realistic. The issue is whether or not Engineering Drawing is essential to an engineer's education. Either it is or it is not. If so, then it deserves sufficient time and qualified personnel to do a good job of teaching the true fundamentals of drawing; if not, then let us eliminate drawing courses from the curricula, rather than give such meager courses which at best result in embarrassment for the young engineer and loss of prestige for the institution from which he graduated.

ANNUAL MEETING

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Candid Comments

Statement of Carey H. Brown, Chairman, Engineering Manpower Commission of Engineers' Joint Council, Before the Committee on Armed Services, U.S. Senate on February 11, 1952 in Connection with S-2441

The following statement, of interest to members of ASEE, was made by Mr. Carey H. Brown, Chairman, Engineering Manpower Commission of the Engineers' Joint Council, before the Committee on Armed Services, U. S. Senate on February 11, 1952 in connection with Bill S–2441.

The interest of the Engineering Manpower Commission is in the training, allocation, and utilization of engineers to insure their maximum contribution to the national defense and to the national health, safety, and interest.

The Engineering Manpower Commission recognizes that in an all-out war there will be no Zone of the Interior and that civilians will be subjected to many if not all of the hazards to which members of the armed forces are subjected.

The Engineering Manpower Commission therefore emphasizes the principle that there is a universal obligation upon every man and woman for appropriate service of which each is capable in maintaining the security of the United States.

It is further recognized that as a people we have less manpower than our potential enemies and that it is therefore of fundamental importance that each person be utilized at his highest capability. In view of the wide range of talent and training necessary to adequately staff our civilian economy, military operations, and production, the wisest system of selection is necessary.

It is further recognized that maintenance of a sound economy and of the required production of weapons are both essential if the man at the front is to be effective, and that these are part of an inseparable whole in maintaining the security of our Nation.

In connection with current proposals for the activation of universal military training, it is imperative that the above principle be applied.

The Engineering Manpower Commission favors Universal Military Training, observing, however, that the provisions of P.L. 51, S.2441 and H.R. 5426 do not adequately make provision for maximum utilization of those who complete their training and enter reserve status.

It is therefore important that the following pertinent principles be established now and incorporated in S. 2441:

(a) Upon completion of their six months training under UMT, the recall to active duty from reserve status of the required number of professional and scientific students should be held in abeyance until completion of their professional study or until they cease to satisfactorily pursue such study. Speaking only for the engineering profession, there is a current requirement for 60,000 freshmen each year in all branches of engineering to meet the need for engineers in the armed forces, in design, development, and production of military equipment, and in the civilian economy.

As a suitable method of accomplishing the above, we suggest the following amendment:

"Amend existing paragraph (3) subsection (D) section 4 of the Universal Military Training and Service Act, as amended (P.L. 51—82nd Congress) by inserting at the end thereof the following: 'Provided, however, that any person who is satisfactorily pursuing a full-time engineering or scientific course of instruction at a college, university, or similar institution of learning shall have his recall to active duty delayed (a) until the time of his graduation therefrom, or (b) until he ceases satisfactorily to pursue such course of instruction, whichever is earlier.

" 'Provided, further, that the total period of liability for training and service of a person so delayed shall be extended by the period of such delay.' "

(b) Since the principle of selection must be applied in connection with the recall of reservists to active duty to assure the proper allocation of critical skills between the civilan economy and the armed forces, reservists should be called to active duty only by a civilian agency such as Selective Service, and not by the Armed Forces.

The civilian agency of Selective Service has functioned in the past to make selections for military service and for the necessary economy; such selections being based upon considerations of meeting military requirements and at the same time preserving essential production facilities. Selective Service can readily be adapted to carry out the selections advocated above, so that appropriate determinations can be made to promote the best utilization in the national interest of professional and scientific personnel now in short supply.

As a suitable method of accomplishing this, we suggest the following amendment:

"Whenever it becomes necessary to recall reservists to extended active duty involuntarily, such individuals shall be recalled by the Selective Service System under uniform regulations to be prescribed by the President and all provisions of the Universal Military Training and Service Act, as amended, concerning classification shall be applicable to the recall or delay in recall of such individuals by the Selective Service System."

I would like to thank the chairman and the members of the Committee for the opportunity to appear in connection with the hearings on S–2441.

TIMELY TIPS

The Direct Approach to Deflections and Intermediancies in Bending

By RALPH H. UPSON
Professor of Aeronautical Engineering, University of Minnesota

(Papers submitted for TIMELY TIPS should not exceed 3 pages of typewritten double-spaced material, including any mathematical formulas, and should contain not more than 2 illustrations.)

In his "Timely Tips" article in the October issue, Professor Jackson performed a much needed service in pointing out the need for a return to basic principles in the undergraduate teaching of beam deflections. Fancy methods and specialized shortcuts may be great fun for the teacher and are often justified for engineering specialists, but have no place in an undergraduate curriculum. In this fast growing field of constantly increasing complexity, we must occasionally review the content of our courses, discard the gingerbread, and go back to basic elements, the real staff of engineering life.

Although in the right direction, it is felt that Professor Jackson does not go far enough in the simplification or generalization of his subject. For some years we have used in aircraft structural courses at the University of Minnesota a method that we call the Direct Approach, along lines closely analogous to Professor Jackson's, but which is still more elementary and universal in its application. Emphasis is particularly put on the angular deflection of an infinitesimal beam element which forms the basis of the entire procedure. Such an element is shown in Fig. 1 (corresponding to Professor Jackson's Fig. 2).

Referring to Fig. 1, it will be noted that the change in angle $d\theta$ at the opposite ends of the increment dx is the usual direct function of the local bending moment of the beam, the section moment of inertia, and the modulus of elasticity of the material. The vertical deflection which this angular change causes at some other point B, a distance of Δx_B is:

$$dy_B = \Delta x_B d\theta = \frac{\Delta x_B dx}{R} = \frac{\Delta x_B M dx}{EI}. \quad (1)$$

Our further development of the method proceeds directly from the integration of angular increments $d\theta$ and deflection increments dy. For example, Fig. 2 shows a portion AB of a deflected beam—no matter where taken, how loaded or supported. The difference in angle (assumed small) between the tangents at points A and B is given by

$$\theta_{AB} = \int_B^A d\theta. \quad (2)$$

The deflection or vertical offset of point B relative to the tangent at A is similarly given by the integration:

$$y_{BA} = \int_B^A \Delta x_B d\theta. \quad (3)$$

Relative to the chord line AB, the actual angle of the tangent at A is obviously

$$\frac{y_{BA}}{x_{AB}} = \frac{1}{x_{AB}} \int_B^A \Delta x_B d\theta. \quad (4)$$

Knowledge of the latter as a starting point now permits integration of the

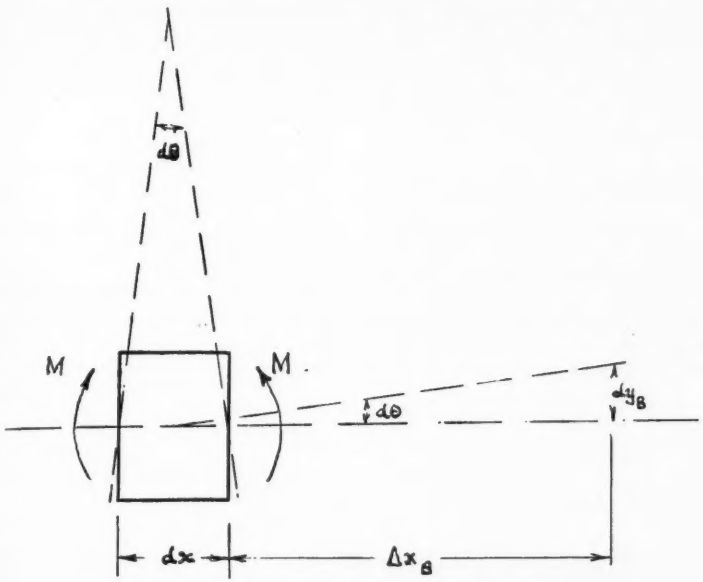

FIG. 1.

angular change and linear deflection at any other desired point, by exactly the same method as already illustrated in the case of point *B*. It is apparent that such integration need not necessarily be mathematical, but may alternatively be performed graphically, equivalent to the moment-area method.

For statically indeterminate conditions, exactly the same principles apply, it being only necessary to supplement the conditions of static balance by equations expressing the deflection conditions, to provide a solution. For example, a cantilever beam, with a simple support in addition, gives the condition of a

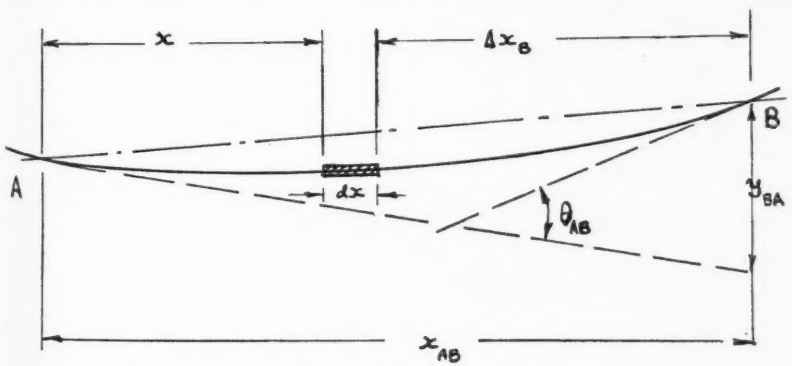

FIG. 2.

known angle at the fixed support and a known position at the simple support. For a continuous beam with multiple simple supports, the supplementary condition is that the deflection angle is the same immediately to each side of any one support.

Essentially the same method can be extended to the solution of slender curved beams and closed frames, the condition for the latter being that an integration all the way around gives zero angular change and zero linear deflection. The deflection in the general case is handled in components in any two convenient mutually perpendicular directions, the x movement being controlled by the y arm and vice versa, exactly as in the beam case already given. A convenient aid in visualizing the case of an initially curved member is to think of each infinitesimal element of length ds as initially straight.

It is admitted that this approach does not provide a ready-made formula or method, convenient to pick up and use for a specific purpose, such as the three-moment equation or the unit-load method, but it is far more adaptable and should provide a more understanding grasp of whatever specialized methods the student may later choose to use.

English Division Summer School

Theme: Orienting the New English Teacher in the Engineering School.

Session I, June 20, 9:00 A.M. Topic: The English Teacher in the Engineering School.

Session II, June 20, 2:00 P.M. Topic: Has Freshman Composition Failed?

Session III, June 21, 9:00. A.M. Topic: Standards of Correctness: Prescriptive vs. Descriptive Grammar.

Session IV, June 21, 2:00 P.M. Topic: Articulation of High-School and College English.

Session V, June 22, 2:00 P.M. Topic: What Literature to Teach and How to Teach It.

Section Meetings

Section	*Location of Meeting*	*Dates*	*Chairman of Section*
Allegheny	Pennsylvania State College	April 18–19, 1952	E. B. Stavely, Pennsylvania State College
Illinois-Indiana	University of Illinois	May 17, 1952	D. G. Ryan, University of Illinois
Kansas-Nebraska	University of Nebraska	Nov. 16–17, 1951	Kenneth Rose, University of Kansas
Michigan	University of Detroit	May 10, 1952	W. P. Godfrey, University of Detroit
Middle Atlantic	Villanova College	May 10, 1952	S. J. Tracy, Jr., City College of New York
Missouri	University of Arkansas	April 5, 1952	R. Z. Williams, Missouri School of Mines
National Capital Area	Howard University George Washington University	February 5, 1952	W. Oncken, Jr., Bureau of Ordnance
New England	Worcester Polytechnic Institute	Oct. 18, 1952	E. T. Donovan, University of New Hampshire
North Midwest	Iowa State College	Oct. 3–4, 1952	S. J. Chamberlin, Iowa State College
*Ohio	Ohio State University		W. F. Brown, University of Toledo
Pacific Northwest	University of Washington	April 25–26, 1952	T. H. Campbell, University of Washington
Pacific Southwest	California State Polytechnic College	Dec. 29–30, 1952	S. F. Duncan, University of Southern California
Rocky Mountain	University of Wyoming	April 19, 1952	E. J. Lindahl, University of Wyoming
Southeastern	Clemson College	April 10, 11, 12, 1952	R. L. Sumwalt, University of South Carolina
Southwestern	University of Houston	April 25 & 26, 1952	H. P. Adams, Oklahoma A. & M. College
Upper New York	Alfred University	October 10–11, 1952	R. M. Campbell, Alfred University

Members of the Society are welcome at all Section Meetings

* No Date Set.

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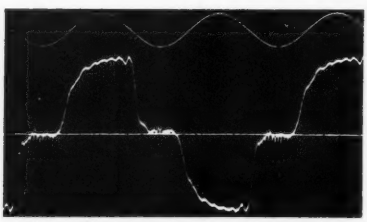

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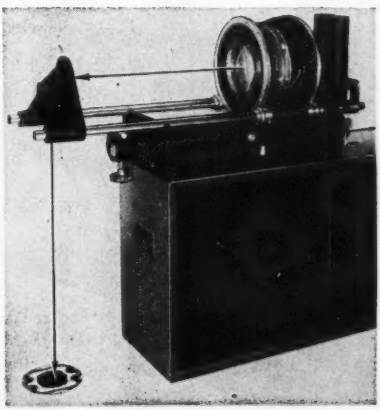

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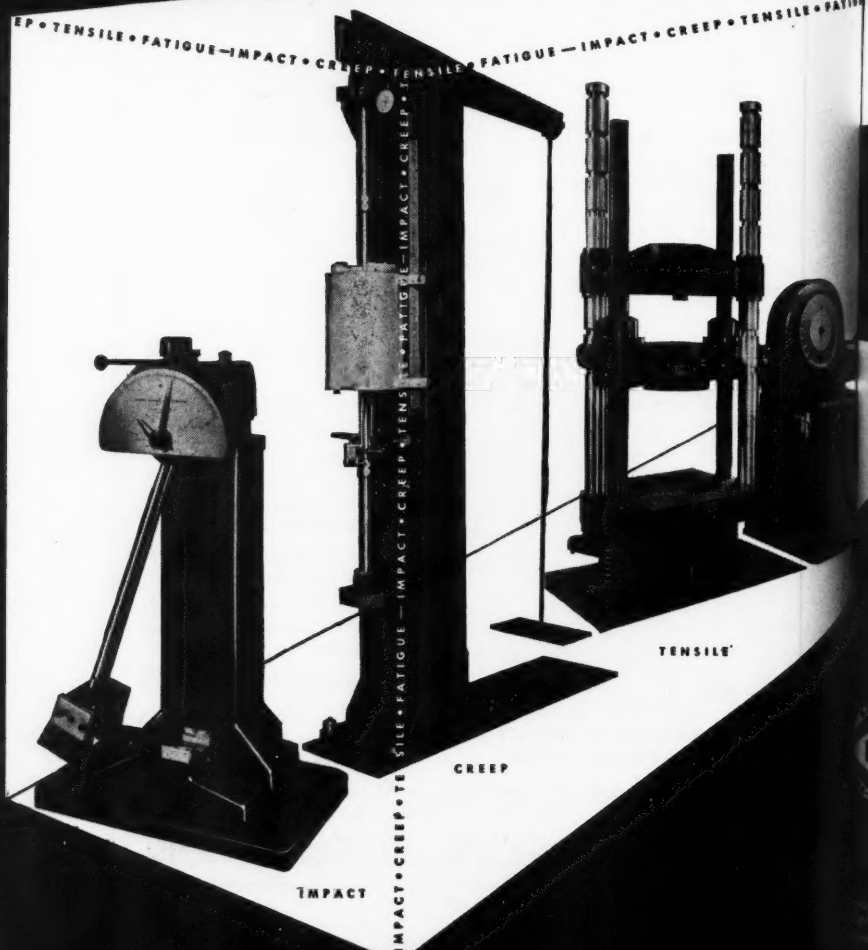

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